

3 June  
with 1930  
A. A. Stewart

Music Mountain west of Peach  
Springs, Arizona.

The lower portion of the slope  
north of the road is granite.

~~Tapeats~~ Lying on the granite is  
about 10 feet of quartzitic  
sandstones, cross-bedded, usually  
purple or purple streaked,  
in other words the usual  
Cambrian basal quartzite.

~~Bright Angel~~ This grades up into a thin  
series of typical Bright Angel  
shale. It is calcareous, brightly  
colored with perhaps a belt of  
sandstone layers and perhaps  
also lime.

~~Muar~~ This shale grades upward into  
Muav limestone, which here attains  
a thickness of 800-1000'. Compared  
with the Grand Canyon the main  
difference noted, in general, was  
the true mottling rather than  
subbly structure. The mottles  
are yellow sandy patches,  
either in the form of bivalve  
spots or worm tubes. Some of  
this bed resembles the "wormy"  
Eldon of B. C., except that the tubes  
(irregular) are yellow and not

Music Mt, (cont)

white.

Much Girvanella occurs here. It is a little larger than is usual for the M.C. type, but otherwise quite similar.

Tribolite fragments (unidentifiable) occur in the lower Muav as well as in the sandy layers of the underlying Bright Angel

Devonian follows.

[Dr. Stoyanov has measured section [7]

5 June

W.H.

AA Stoyanov

East of Del Rio, Arizona.

On the edge of the plateau at this place, the granite is exposed, overlain by a sandstone like the Apache Shale which is succeeded by Devonian limestone.

A little to the north of this first locality a thick series of metamorphosed quartzites intervenes between the granite and the Devonian sandstone.

Algae in Chuar series.  
Naukowea -

Lowest Simply crinkly bedding. Up to several exposed feet in thickness.

Occurs above white, strongly crossbedded base formed coarse ~~to~~ sandstone. Forms layer perhaps 10' thick over whose rounded masses the overlying shale is laid in sharp folds. In the lower part of the formation the individual colonies are small rather irregular cylinders which sometimes bend rather sharply. These cylinders show the regular Cryptozoids structure and widen a little as they grow. Taken together they form large masses that are described below. In the upper part of the bed the small cylinders give way to large rounded heads. Both the cylinders and large heads combine to form huge vase-shaped masses. Usually the base is narrower than a regular flare would require.



Walcott makes a good drawing in his note book. Sample of the small tubes taken.

Alga (Chun) cor.

upper zones. Irregular broken, usually blackened algae. Some appear to have been turned over by the waves.

Above this zone there is an oolite layer that is usually altered to black chert. The oolite

Topmost limestone has very little algae. all are indefinite and broken.

19 June

1930

With E. D. McKee

Kaibab Trail.

Above Porcupine house.

Tapeats typical in character and  
thickness

Nankoreap Creek,  
Lower Portion [Box canyon  
above Colorado R.]

24 May

with 1930.

Dr Stoyanov

Beds tilted toward river at about the same angle as the stream grade, in consequence the creek flows in the maar almost all the way.

Just above the box canyon on the west side the maar is faulted against the Tapcato - at x in a thin



sandy layer I got fossils - Dorypyge. Dr Stoyanov and I agreed, after considerable search that these are actually in the maar, which therefore proves conclusively that this formation is Middle Cambrian as we had previously deduced on theoretic grounds.

Recent Algal deposits in  
Mankowrap Canyon.

Gravel and sand along stream  
either above or below the water level  
is cemented.

#

Below camp in side canyon a seep is depositing  
much lime.

#

At camp springs are depositing lime  
white spongy type with leaves and stems  
enclosed.

#

Elsewhere where water first issues  
trifia usually occurs.

Arizona  
Grand Canyon  
Malcott 1879

~~B. 83~~

Chas. Walcott  
U. S. Geological Survey.

~~0.591~~  
~~0.54~~  
0.099

18698

Notice strata at stream <sup>52</sup> E. of  
Carboniferous, also character  
of bedding through sand.

Aug 12<sup>th</sup> 79.

1

Ascended hill directly west of  
Kanab. at 200 feet (Aneroid) above  
the level of the stream found small  
shells in <sup>brownish-</sup> red sandstone and 25 feet  
stone lithic remains, both fossils  
undeniably of two species, spent the  
afternoon searching for them.

Aug 13,

Hills 5 miles S of Kanab.

(1)

Brown soft shales, crumble gypsumous  
resting on tan-colored 90 foot  
shales

3 massive layers, sep by fine  
shale, & on top as one breaking into  
thin shales, brown & chocolate 50 feet

3 massive

beds of brown shale 30 feet.

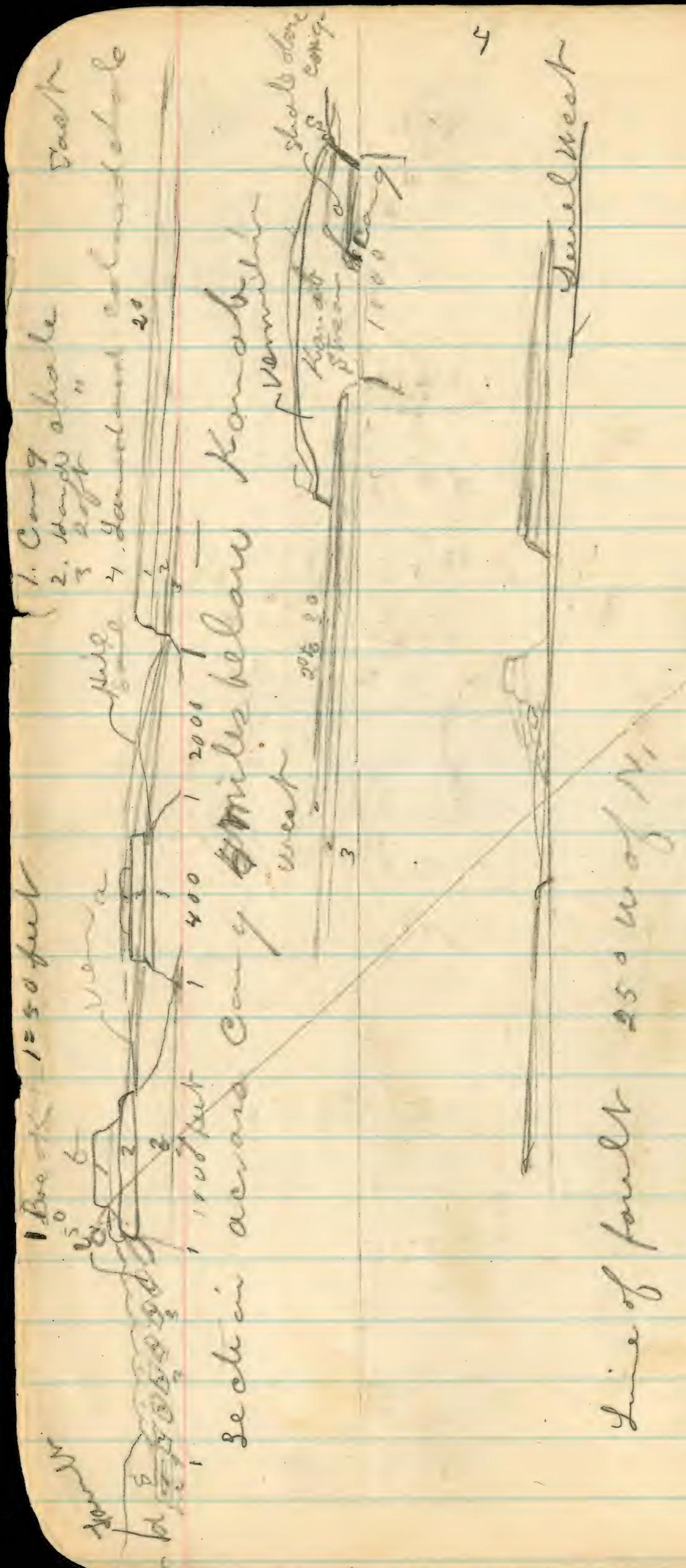
light colored sand  
with large fragments of  
silicified wood | 50 feet.  
This is overlaid by a thin  
sandstone similar to the  
one just described  
Thickness - 20 feet to sum't of  
hill (Section Contained about 6)

From the point of a sharp  
ridge to the right, capped with  
brown sandstone, running  
out from the east side of  
the Wash valley 4 miles  
below the top of the mesa  
of the Vermilion Cliffs  
was one above the other  
to the east & west of  
the canyon.

The sharp crevices  
abut so closely the latter  
is entirely (nearly) hidden  
in the fill a mile or two  
back from the mouth  
to the west it passes

carbonate. (3) The Conglomerate  
consists largely of coarse  
gravel, mainly of sand with  
small quartz pebbles scattered  
through it. Megalites,  
with an occasional few  
pebbles, form the top  
thickness. The silicified sand  
of the sandstone bed is thickened  
and broken before being interbedded  
in the sand. Some larger  
are rolled sand (which  
others evidently were the  
~~they~~ (interbedded) to  
one more massive sand 6 x 5 ft  
upon which there was a  
pile of silicified wood  
in the sand. Conglomerate  
fragments in sand & short  
length others sand thicker  
all water worn rounded.

Dip of Conglomerate beds N. 17° E  
" Vermilion Cliffs" "



11

## Line of power

The Conglomerate<sup>(5)</sup> gradually rises  
forward the west until a break  
is met with on the east side of  
the valley this results from denudation.  
The strata are nearly horizontal  
(a) + is slightly tilted  
at (b). at (c) there is an amphitheater  
+ descends to the west a 125 feet below  
(b+d). The line of the fault could  
not be accurately determined  
but it is not far from the  
edge of the



Con of section (6) from page 12)

For a distance of two miles directly north across the valley the strata are buried beneath sand + decomposed rock (shaly + dolomitic gypsum marls). Began measurements with Locks line at first appearance of banded marl. Decomposed, a long low foothill running south from 8<sup>th</sup> Cliff (Headland) w of Kanab canon. To the base of the cliff the strata are composed of slate, dark purplish brown greenish + bluish-green colored gypsum marls which have decomposed + formed low rounded foothills near the cliffs or else stretch out as a level plain to the conglominate. The marls are variegated in color and contain both nodules of <sup>white</sup> gypsum + layers of nearly pure gypsum.

~~Thickness of measured section~~ 350 feet.

The base I have taken for the Vermilion Cliff this is a band of sandstone, it is low to the

(7)

5850  
5335  
225

light colored ~~clay~~ (foot) overlaid by ~~the~~ reddish-brown sandstone. The layers are from 2 to 7 feet in thickness, total thickness <sup>B-5975</sup> of stratum. 20 feet

Succeeding this there is a mixed mass of marls + shales and layers of soft ~~slightly~~ reddish-brown sandstone (tot) 70 feet. This is succeeded by a mass of a.s.s.d. which is soft + easily disintegrated, numerous thin pinnings of shale trail back it into layers of from 1 to 6 feet in thickness. Total 120 feet

Total to base of fish beds

Locks line 210

Average 200+

An 5975

He offer portrait of these red beds are more compact + thicker. The lower 150 feet of the above 210 are nothing but passage beds to the Vermilion Cliff from the Shinarump Ch.

At this point there are 3 light sandy layers with shaly (4 feet) partings & then 6 feet of fine argillaceous & sandy shales they vary in color from lead through brown to red with fillets of greenish color, as yet this portion has present but a few fish scales.

This bed is separated from a sandstone similar one above by a narrow band of fine light colored sandstone varying in thickness 2 to 4 feet in thickness. The entire band varying from 20 to 30 feet in thickness. This band is strongly defined at all the prominent headland points cutting out from the main cliff & appearing resembling a striped ribbon on the face of the red sandstone wall, as the massive shales above & below frequent-

present a bold escarpment. It is also of unusual interest as to the present time it has offered none fossil than any other stratum below the first above the Shaverock Conglomerate. (25 feet) Massive light (colored) brown layers, 50-feet

The cliff is again divided by bands of ~~argillaceous~~ shale and thin beds of sandstone. This bed varies in thickness at this point crossed by the section it is (fish bed) 25 feet. This is succeeded by bedded sandstones varying in shades of red & light colored sandstone extremely by one red column wash'd from stone, the layers are irregular in thickness & contain thinings of soft rock with layers of wood

(10) (50 +

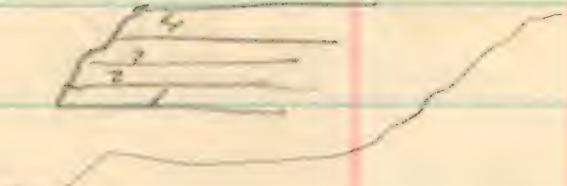
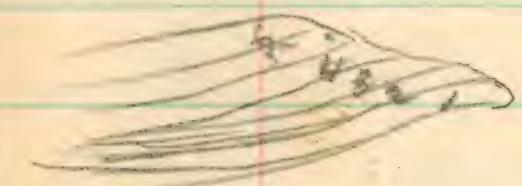
etc., Sodolithus formip's also penetrate the bed in many places, where especially abundant the rock is of a yellowish cast, thin beds of conglomerate occur but most of limestone. To the summit of the first white capped cliff above the second fish bone.

bed 230+

This level is the one on which  
the original town site  
is located. East of town  
is built. It marks a readily  
recognized horizon & divides  
the lower part of the  
group from the more upper  
volcanic beds above.

An 918 (11) An 6175

Section of beds above Conglomerate  
S. W. of Kansab. Did not make  
section here as these beds nearly  
as great as the available section  
take 2 of sand. 9 mi. N. E. of Kansab  
a fault breaks the line of cliffs.  
The western cliff terminates in  
a somewhat bold escarpment.  
The interval between the cliffs  
is a hill cut out in a  
shallow valley running roughly  
to the north.



The cliff on the east side rises a very little towards the edge. The fish banked is readily seen at each about  $1\frac{1}{2}$  miles distant. On the west side it has a dip of about 5° to the sea.

(2)

Aug 23d) Continuation of section  
for page 10.

The light gray <sup>red</sup> cap of the  
~~Kanab~~ a ledge of reddish sand  
about 20 feet thick. It is a persist-  
ent feature in all the cliffs  
about Kanab & may be seen  
up the valley for two miles  
where it disappears owing  
to the dip & the rise in the  
bed of the valley. The  
section is taken up, two miles  
above Kanab, just above  
the spring well.

The strike of the strata appear  
to be a little S of west (20°)

The dip 1.75° N.

Above this rest 180 feet of dark  
red sandstone with thick lenses  
alternating with shale &  
readily decomposing. Ripple  
marks indicate a shallow  
water deposit formation.  
The light colored sandstone  
comes to predominate

(3)

above this, & forming the same  
miles as at the base of the Gp.  
It shows the character of the  
succeeding division commences  
to predominate the line of  
separation between the vermillion  
-var & white cliff divisions  
of the ? Group is  
placed here, 20 feet of finely  
bedded sandrock (light-colored)  
followed by a massive layer  
of light gray sandstone  
which is slightly cross-  
bedded. This is a strong &  
well indicated horizon all  
along the cliff at Kanab  
& up the canyon for 16 miles.

white cliff Gp.

finely bedded light colored  
reddish sandst. 20 feet  
massive tabular horizons  
cross bedded 20 feet  
massive cross bedded, light gray  
with occasional reddish beds

(14) irregularly intercalated 300 feet.  
The upper part of this mass  
consists of a light colored ~~pink~~  
soil which easily disintegrates.  
This is a most beautiful illus-  
tration of cross-bedding in this  
upper portion, especially the  
crossing lines running obliquely  
horizontally above stolæ.

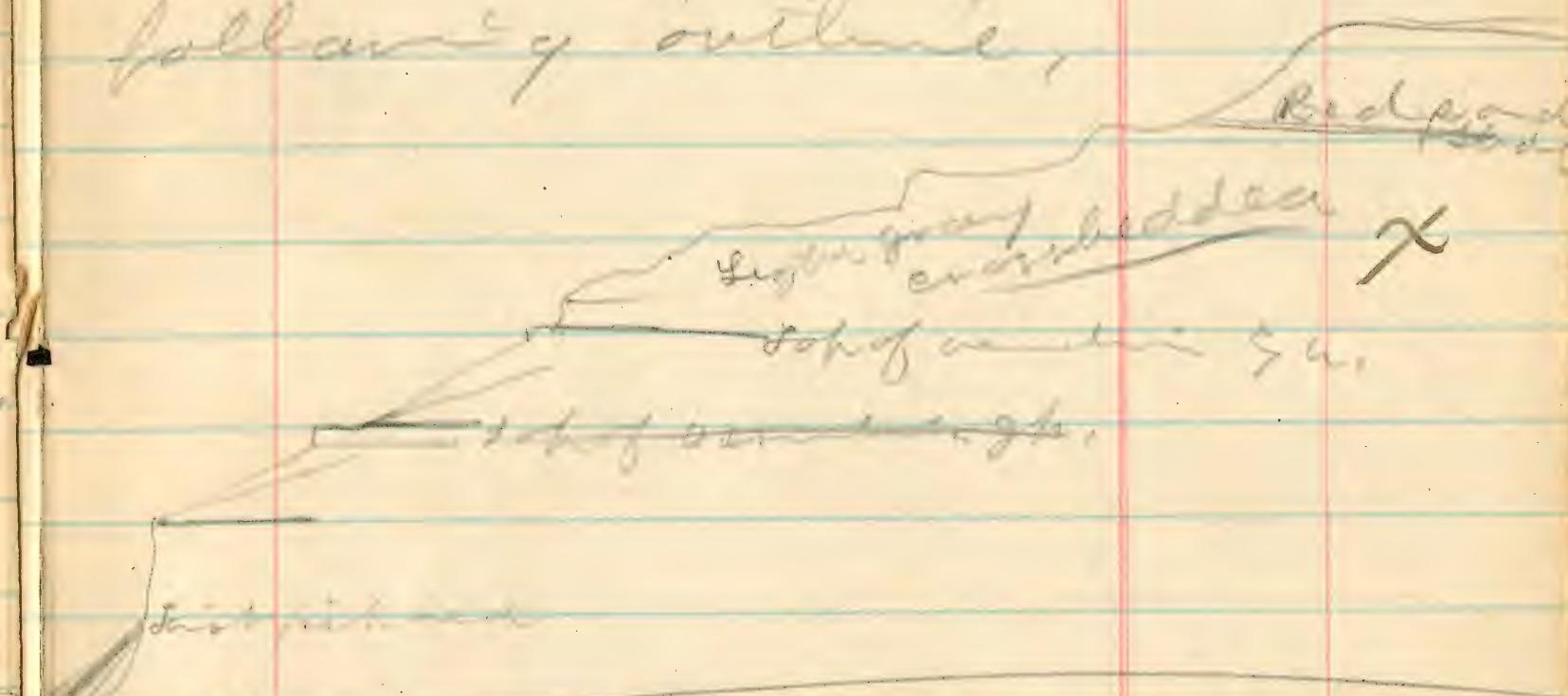
Some evidence of coarse风化  
in the lower portion.  
Above this there is a distinct  
sandstone & the slight intercalations  
of the white fine-grained  
in the upper portion the  
light colored sandstones  
above appear.

Thickness

120 feet

The upper portion is indicated  
by a light shaded area.

(15) a view of the west cliff at  
the mouth of the Laramie River  
Vermilion Cliffs presents the  
following outline.



The white sandstone is  
divided into six principal  
beds by subhorizontal  
partings of more indurated  
shaly sandstone, which separate  
the cross-bedded massive  
layers. The latter are  
not of uniform thickness  
at all places, varying from  
30 to 60 feet but the  
divisions are readily seen  
on all natural cliffs.

Aug 27<sup>th</sup>

(16)

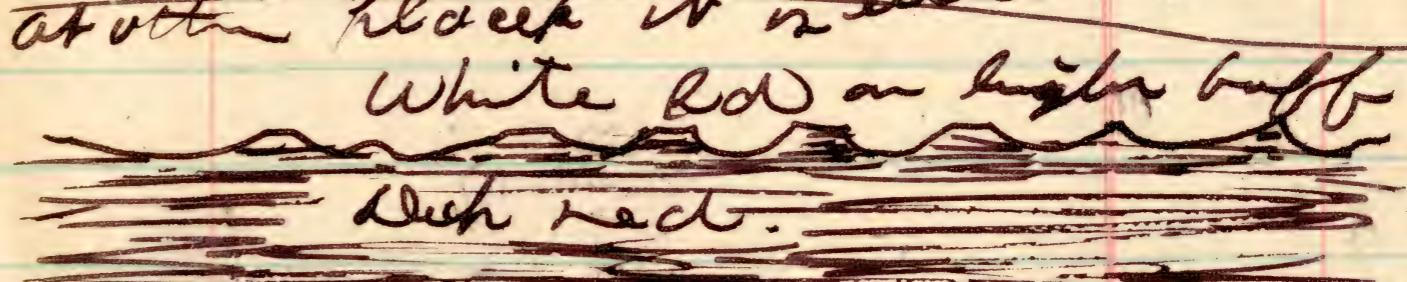
Tracing the red bed in the main canon & also in many of the lateral canons it is seen to be a uniformly bedded deposit. A number of thick layers alternate with the chalky beds until towards the summit where the thick beds are indurated & present a strong dark brown color, and beneath a ~~deposit~~ stratum of (horizontal) bright colored gray sandstone which is succeeded by curved & twisted layers & then by the crossbedded sandstone. This red bed is a ~~result of the~~ configuration of conditions which formed the red beds of the Shinnecock & vermillion cliff lps. In the Kanab & lateral canons it is usually capped with a layer of calciferous sandstone. All the stone ~~pebbles~~ of the canon are poor

(17)

than from this horizon.

Continuation of section above red bed. Aug 28<sup>th</sup> 79.

The red bed is ~~succeeded~~<sup>capped</sup> by an evenly deposited layer of fine grained <sup>dust</sup> red sd. usually streaked with white for the cliffs alone. The upper surface of this stratum presented the following aspect when exposed on a freshly broken surface.



The two beds were closely & firmly unitid showing that the white sand followed the red without ~~an~~ <sup>an</sup> ~~intervall~~ <sup>intervall</sup> of time.

The buff bed is succeeded by a mass of beautifully banded vermilion & buff sds. Crossbedded.

Next comes a great mass of reddish & silvery cob. sds

18

They extend to the vermilion colored beds beneath the White cliff. They are composed of several thick bands divided by horizontal ~~surface~~ lines separating it into layers from 25 to 100 feet. The beds are composed of angular bedded layers of from  $\frac{1}{16}$  to  $\frac{1}{4}$  in thickness. The thinner layers predominating. Occasionally a thicker layer (4 $\frac{1}{2}$  to 12) feet occurs but it is usually irregular & of slight angular extent. At various places in the stata, usually near the summit of one of the crossbedded bands the layers & curved & twisted, giving a gnarled & knotted appearance. The first example was seen when it appeared as though at the hollow bed.

(19)

of an unbroken seabed later filled up & leveled off to make way for the floor for the succeeding stratum. Thickness of beds from red bed to vermilion beds a base of great white cliff stata. ~~To~~ Vermilion bed is flat. 700. To base of White ad in cliff 1100. The buff, gray & reddish brown layers are intermingled & also deposited in irregular bands. The deep red & vermilion beds predominate towards the summit of the mass 350 feet above the base red bed.



The <sup>5<sup>th</sup> 700 feet of strata crossing the intervals between the headwaters of Kanab creek (springs below White cliffs) is c. b. sd. red, varnish red, vermilion with an occasional fillet of white. The upper portion merges into the white cliff sd by an irregular line of contact tunic. The change is in the colors.</sup>

The upper 400 feet is mostly of a vermilion hue & is a soft easily disintegrates sd. It may be foothills below the cliffs. The <sup>west</sup> cliffs all present a rough surface to the south and large masses are separated as buttes. Above the vermilion bed, which is a somewhat fluctuating horizon the true light gray or white cliff tunic

massive light colored divided into fine principal beds each consisting of fine. cross beds 575 feet.

Capping sandstone of a reddish hue. 100 feet. upon this rests a limestone containing fossils.

Notes of white cliff sandstones.

Sectarian It. Upper Kanab.  
Buff sandstones etc directly  
west of Pink Cliffs.

(1)

a. Buff sandstones (hard) alternating with clays & marl.

(2)

a. Marl & sandstones hard  
and not readily disinter-  
grading. <sup>30</sup> feet

b. Hard buff sand <sup>20</sup> "

c. Alternating bands of ~~marl~~<sup>clay</sup> & clay (weathering purple, lead  
color & white or light gray)  
& buff sandstone <sup>150</sup>.  
at this point found fresh  
water shells in a bed of

light clay. 20 heavy bedded  
buff sd/ <sup>30</sup>

(d.)

Heavy beds of buff sd.  
with fossil shells &  
plants. <sup>30.</sup>

8. Light layer of ~~sd~~ + 60  
clay ~~50~~  
~~ft.~~

9. Heavy bedded buff sd with  
fossils <sup>125 feet</sup>. The fossils  
occur in a calciferous sd  
which occurs in a some-  
what irregular beds near  
the summit of the mass and  
also again <sup>50 or 60 feet</sup>  
above the clay bed beneath.  
Thickness to clay bed ~~9~~  
<sup>155 feet</sup>

g. An irregular bed of clay  
+ fine buff sd. Clay bed  
color contains fossils.  
Plants found

h. Massive buff sd

i. Clay <sup>sd as h)</sup>  
"layers containing  
shells, first a few shells  
at base in dark clay 12 "

j. Massive sand buff 15.

k. Soft fine sand with  
purpleish clay beneath  
holding fossils. 30

l. Massive buff sd with  
a party of clay. <sup>25</sup>

m. White sand with  
bed of fine conglomate  
near the summit <sup>170</sup>

The section down to the white  
conglomerate is an alternation  
of buff sandstones with  
clay bands. One <sup>thin</sup> bed

calcareous layer persistent  
only for short distances still  
occurs on the same horizon  
at different localities and  
met with holding fossils  
Fossils also occur in the  
sand layers but are

widely in poor condition.  
 + looks like broken iron stained flint  
 thus out, the surface of  
 fine yellow sand & clay is  
 the best matrix found  
 etc, the thick black  
 colored clay weathers to a  
 light gray & it's the cliff  
 below. The common  
 out at the summit of the  
 is from 15 to 20 feet thick  
 + persistent as far as you  
 examine it has yellow  
 mottles. The light gray or  
 white sand also separates  
 easily + has caused the  
 cliff back so that the  
 exposure of the upper  
 rocks let down across  
 ridge of the divide.

(n)

At the base of the ~~the~~<sup>united</sup>  
 the ~~is~~<sup>iron stained</sup> a thick  
~~15 to 25 feet~~<sup>15 to 20 feet</sup> followed by alternating  
 yellow shales + clays for  
 a long distance. The clays  
 have undermined the sand  
 & now stand as a series  
 of escarpments.

Beds are thick bedded  
 marl or clay parting 10 to  
 15 feet in thickness.

Somite leaves suggested  
 remains are scattered  
 through the sandstones, figures  
 were taken at 375 feet above  
 white sandstone (marks at  
 500 feet of water)  
 or 375.)

Below the 500 foot level  
 the rock seems more silty  
 for the succeeding 200 ft.  
 a heavy yellowish sandy  
 buff stone, possibly  
 reddish in some 50 ft.

Below white sd -  
this is followed by a coarse  
sd yellow iron stained in a  
narrow band & below white  
or b gray. a few pebbles  
are scattered in the iron  
shallow sand.

The disintegration of the  
white sand leaves a  
scarping below which  
is prominent in all the  
little sides. It is the top of  
the Astrea bed.

The upper sandy shales  
(10 feet) contain few shells.  
Below a small species is  
found with a few of the  
narrow elongate form  
& also lamellibranchiates  
gastropods etc - 25 feet.

The ~~old~~ Astrea bed yellow sand  
filled in places with  
the shells lies below  
40 feet.

The central portion is a  
soft yellow sd + in the  
elongate Astrea is so thickly  
placed (mouth up) that the shells  
touch each in great masses.  
This bed is from 2 to 6 feet in  
thickness + persistent as far  
as yet examined. Exogyra  
was seen lower in the  
bed but was not seen with  
the elongate form. A curious  
commingling of fossils occurs  
in the 40 foot bed, (Recollections).

~~fix note on (N)~~ Sept 27

~~100 ft~~  
~~above the Astrea bed~~  
~~there is a bed of~~  
~~bituminous shale with~~  
a few thin bands of coal.  
The bands up to an average  
thickness in soft white  
sandstone.

30

Sink Valley Conf. left 15<sup>ft</sup>  
7. A.M. 7550.

a 9200. Base of Caving.

b. 9050. Base of t.

c. 8875 175  
Base of c.

d. Adding with 30. to 8875 = 8975  
8850 - 150

sept +  $\frac{25}{150}$

e. 8850  
8575 - 275 +  $\frac{25}{25} = 300$   
Post Hill 8600.

Top of hill, base of t.  $\frac{1}{2}$  mile  
south 8625

Line with strata in hill next  
east 8125. Top of Henryland  
of Buff sd. 7925.

sept 250  
 $\frac{700}{250}$   
880+

7925.

Sect 3777

Sect in west of Clarkton.  
Sept 15. 1879.

Pink limestone

Sandstone grayish colored  
pink by wash from limestone

Conglomerate at base 50 feet

a  $\frac{50}{50}$

Indurated concretion

yellowish brown  $\frac{15}{15}$

Light colored concretionary  
with patches of lead &  
purple colored clay concretions.

$\frac{150}{150}$

c Buff led. massive in larger  
+ also shaly in many parts  
slight patches of marl.  $\frac{175}{175}$

d. Massive buff led 25 feet  
moderately by buff led  
+ a thin bed of mud between  
at intervals  $\frac{150}{150}$

e. Buff led with calcareous  
oblong concretions, few ls.  $\frac{10}{10}$

<sup>30</sup>  
strata below described on side  
valley sides.

g) Massive ad followed  
by clay etc. did not  
continue in side valley but  
went 3 miles east.

Sect 3777

Sect in north of Clarkton.  
sept 15. 1879.

Pink limestone

A sandstone grayish, colored  
pink by wash from limestone  
Conglomerate at base 50 feet

50

Indicated sandstone.

yellowish brown

15

Light colored sandstone extremely  
with patches of hard &  
shallow colored clay & ooids.

150

c Buff ad. massive in larger  
& also shaly in many with  
slight patches of marl. 175

d. Massive buff ad 25 feet  
intercalated by buff ad  
& thin bed of mud intercalated  
at intervals. 150.

e. Buff ad with Calcareous  
stalactite concretions, fossils. 60.

7925.

Below this there is a series of massive buff beds with clay bands indicated by weathering along an sloping outcrop on hill side to a massive buff bed. Thickness is feet thick which rest immediately above a fine sandstone & white sandstone.

300.

The white sandstone with thin fine conglomerate at 150 the bed extends down to a heavy dark buff layer.

150.

Below this there is a series of buff beds with a few clay beds the lower central portion is more shaly & below a white coarse sandstone occurs.

260

2

g. At 191 a yellow sand contains an elongated form of Ostrea. Numerous shells occur in a layer above & below.

40.

h. ~~Massive Buff~~<sup>gg</sup> Are half mile south the same bed is without fossils. It has the same lithological character but along an outcrop of 2 miles no fossils were seen.

h

i. Massive buff sandstone

50

j. Soft sandy layer passing into an accumulation of shale & thin bed of argillaceous limestone. A semi-bivalve argillaceous shell with concentric markings near the middle of layer. 785 ft

Red shale breaking into angular fragments 10 feet.

The red shale contains

soft sandstone, buff with an intercalated mass of lecciated red shale in a matrix of ~~intrusive~~ volcanic matter. The shale is broken and is embedded in the scoriae lava at all angles and in every shape. The mass is ten feet thick in places.

Pecten below not taken.

Dominantly few fossils were seen in the 1 in. of the section both the intercalated & the red shale were devoid of fossils with slight exception.

Shale on shale ~~blue~~ calciated  
above the massive sandstone  
of the astrea bed there is an  
intercalation with limestone  
an argillaceous shale with  
a band of dark brown shale  
six feet from the base which  
contains crystals of dolomite  
and fossil shells. A pectenine  
shale occurs above it and  
then an argillaceous shale  
varying in thickness &  
that to a thick band of  
sandstone 50



Nearly the same mass is  
seen above the astrea bed  
in the Kanab Canon. Examined  
on another outcrop. Sept  
27<sup>th</sup> 1879.

36

37

Section on east side of  
sink valley continued across  
from west side.

Top of I massive limestone  
bed mixed with caglancate

~~150~~  
200 feet

2 Gypsum. White nearly solid  
as

30

3 Conglomerate followed  
by red mud

~~200~~  
200

4 Anthracite coal bed

" Mott - ~~60~~  
~~30~~

5 Brown shale 2 feet.

6-7 Wavy sand (all shale)

8-9 Cream colored  
mud -

10 White sand streaked  
with yellow.

11 is capped by a thin  
conglomerate of varying

thickness. In a distance of  
100 feet it changes from a thickness  
of 1 foot to six. The sandstones  
immediately underlying it serve  
at sink valley may be found  
as a ten foot band of light  
buff sandstone on a bed layer  
or broken up in several thin  
layers all not the same thick.  
a few yards away, entirely  
short as on the Kanab valley  
side just below like old  
places the shales above are  
also very variable. The coal  
seams are not at all persistent  
and the sandstones vary very  
much in thickness.

No 7 is a variable bed. The  
muds beneath are more  
persistent & appear along  
long lines of outcrop.

From my present view I should  
place all the mud in the

Lunatic

1. sand 10 ft. in white  
cliffs. unit of white clay  
intercalations.

2. Buff - cream colored  
fine grained Calcareous sandy  
limestone from 10 to 12 feet  
thick. Riddled with ~~holes~~  
and resting on coarse cross-  
bedded light gray sd. 35 to 40

3. Shaly layers 10

60 65

4. Limestone band) 10

10

5. Shale sandy

50

shaly, sandy layers

25

6. Cream colored limestone  
with fossils

25

7. Thick gypsum nodules  
See pg 39

25

8. Coarse conglomerate  
formed of the fragments

50

42

rounded, rolled sandstone  
limestone. siliceous pebbles  
etc. principal calcareous  
unit with some sand.

b. 115.

Bed of gypsum with small  
gypsum in thick layer 30

i. Low reddish mud hills <sup>alluvium</sup> <sub>in places</sub>  
with remains of con-  
glomerate on the sides  
indicating decomposed  
conglomerate. 200.

j. Anaceous gypsum  
on mud cream colored.  
Banded with red & greenish  
anaceous bands. Capped  
with a yellowish buff sand 325

k. The sand is about 2 feet  
in thickness & holds  
leaves etc. this is followed  
by a band of clay, dark

43

from carbonaceous vegetable  
matter & weathering to a  
shallow purplish hue.

l. Another band of yellow  
sand followed by light  
colored sand in a band  
of gypsum with a dark band  
of clay no coal found. 25

k. Gold Drift sandstone weathering  
white with a dark argilla-  
ceous shale with a band of  
fine lignitic coal, with  
shaly parts. 4 ft thick  
succeeded by the spongy  
mass of probably carbonized  
vegetable matter. 25.

l. Yellow irregularly laminated  
sand of sandstone 3 feet  
followed by numerous  
shaly bands, dark weathering  
and

25

b. Massive, partially c. & f.  
buff sandstone below & one  
mainly bedded c. & f.  
hard calciferous layers  
vary irregularly.

Catani leaves sta. 45  
Shaly dolomitic limestone  
with a thin seam of dark  
shale occur near the  
upper portion between the  
thick layers of dol.

m. Argillaceous shales. Hardening  
into layers of from 2 to 8"  
thickness, measuring in angular  
fragments. Catani shells  
sta. 30 feet from summit of  
this bed there is a seam  
of coal 3 feet thick & 6 feet  
below another of 4 feet.

Gray shale, lenses of coal  
to next buff dol.

4600  
65

n. Heavy buff dol. Soft near  
base & more indurated above  
scattered burning occurs in the  
lower portion. The upper  
layer is a dull yellow. The  
top of hill covered with  
volcanic matter.

To top of dol.

25 4600

o. 10 feet of brownish shale  
followed by a light colored  
sandstone holding numerous  
fossils 20 feet. Up to the  
present examination of  
over 5 miles of outcrop  
on the Sisk & Kanab valleys  
there is here a commercial  
layer of volcanic matter  
which follows the line  
of red shale which it  
holds same fossils as  
is said below. This  
is succeeded by a white  
sandstone 1 foot

irregular layers  
feet

Bitterniss. argillaceous  
shale with concretionary  
nodules containing Ammonites  
Bivalves etc. etc. <sup>small Erogyra</sup> <sub>in art. 2.</sub>

63

80

15 feet of dark colored  
gypsiferous mud followed by  
90 feet of soft yellow sandy  
shale which is capped with  
harder sandstone at top 108

Note. p is more argillaceous than  
bitterniss. The nodules contain-  
ing the fossils vary from 1 to  
2 feet in diameter & usually  
flattened. They occur about  
20 feet from the base above  
there is another stratum of  
nodules of a more crystalline  
character with but few  
concentric fossils.

The sandy shale continues  
across the low flat between  
the south & north sides of the  
valley leading from Hanab  
to Sink valleys and is again  
taken up in the foot hills on  
slopes of the hills to the south.

Concealed partially, soft sand  
shales & arenaceous clays  
100. 150 feet. (Estimated)

7 feet of arenaceous shales &  
the total is 475 feet of 200  
feet of dark colored argillaceous

shales followed by 275 feet  
of arenaceous shale with  
argillaceous bands the  
latter marked by fragments

1 vegetable matter & in  
places slightly gypsiferous.  
The upper part is changes  
in a fine sandy shale  
with a dark clay  
lip.

700.

48

r. Massive buff sand  
in bed resting on talc bed

50.

Note for C. On the pink  
valley side there is a layer  
of soft coal 4 to 6  
feet thick beneath the  
sandstone in the bituminous  
shale. It was also seen  
in a ravine on the Karab  
side above Silver old place.

Note on p. The nodules with  
fossils were found at the  
same geological horizon  
on the pink valley side.

When exposed to the weather  
the nodules break off in  
many pieces leaving a soft  
matrix. The fossiliferous  
fragments can be ground  
in many small knolls  
holes.

49

Partial section of con-  
ical bed. Pink valley  
side resting on white sand-  
stone which passes down  
into arenaceous clays etc.

a

Buff sand) 2

e Bituminous shale 20

f Sandstone 2

g Arenaceous shale 20

h Dark lith. shale 12

i Clay bed 3

j Coal seam. Dark  
lith. lighter  
dol. lignitic. Contains  
passing into brown  
lignite 9

k Ch. shale. brownish 10

9	Sandstone	
10	Arenaceous clay	23
11	Shale	5 - 10
12	Gypsumous clay	23
13	Coal	15
14	Arg + arg shale	45 - 8
15	Rd	10
		147. -

This corresponds to K. 1.2.3. etc  
of sections from the Trossie  
Up Cut on the Kank Valley  
side. The upper coalbeds  
of that section are circled  
in this. K 2 contains the  
coal seams (?)

Section from the upper part  
of the White Cliffs on the  
west side of the Kank Valley.

### Trossie.

a. Limestone, much bedded.  
gray, very hard, little ring  
under the hammer.  
Contains fossils in the lower  
shaly layers.

b. Sandstone. Coarsely bedded.  
gray + purple, streaked with  
brownish passing down into  
a limestone band and again  
sandstone to the top of the  
c. sandstone.

The purple gives way to  
white + the yellow comes  
beneath. This is not  
symmetric owing to dol's

c. Solid cliff w. c. b. rd.  
85.

50

b. Vermilion band c.b. soft  
readily disintegrates, etc.  
extending across valley.

600 - 700

c. Gray to red band c.b.  
red massive & deformed  
in bands from 20 to  
100 feet.

300

d. Red sandy dolomite <sup>50</sup>  
Red - c. Red bed (9) <sup>measured</sup>

125

e. See pg 16

gray a. above to  
red band. ~~is same~~

320.

f. See pg 15.

g. Sandy bedded.

f. g. Massive dolomite  
partially c. b.

20

g. h. Light red color  
easily bedded sd  
with thin layer  
of gray sandstone

20

51

i. Dark red sandstone  
massive layers alternating  
with shale. soft &  
disintegrates easily  
forming a sloping  
slope above the gray  
sd beneath (pg 12.)

180

j. Light gray sd

5

k. Bedded sandstones  
varying in various  
shades of red & gray.  
The layers are  
irregular in thickness  
and some disintegrating  
partings of less in-  
-dicated sd.

230.

l. Thin layers of sandstone  
alternating with beds  
of orange-yellowish  
color fibrous etc

10

52

m & massive, thin-shelled  
layers.

n m Alternations of sandstone  
layers + argillaceous  
shales holding fish  
remain etc

Pg 8.

50

o n Bluest + sandy  
shales with

s Radish brown ad

r easily disintegrating  
with patches of  
shale breaking into  
layers of fine sand + silt  
with thickness

25

Pg 9

t o Muds + shales with  
bands of ad.

Pg 6

120

g h Radish brown ad with  
white sandstone

71

20

2305

53

g a Shaly inter-

shale gypfirous.

Dense felsitic, brown  
green + bluish green  
disintegrated form  
in low foothills.

650.

b

Pg 6.

Gray clayey shale

Pg 2

c

Radish brown shale

50

d

Massive layers ad  
separated by fine  
shale Pg 1.

50

e

Brown soft shale  
gypfirous

15 20

f

Light colored  
gyp. shales

120

Lop 5550 Lop  
5450 Lop 25

g

Red gyp shale

100 100

h. ~~Impure limestone~~  
holding cast of fossils  
and also in the pure  
limestone well preserved  
shells. Gastropods brachi-  
opods and bivalvibranchs.

i Red mud 4<sup>th</sup> 6  
15<sup>th</sup> 40

j Impure limestone with  
indicated gypsiferous  
calcareous shale.

k Red gypsiferous shale.

l Impure limestone shaly  
breccia (see pg 54) 2<sup>5</sup><sup>th</sup> 10.

m White mud 2 but with  
some gypsiferous (see cl)

70

n An west side is composed of first  
gyp mud & shist alternating.  
Solid on Butte in west side

On the west side of the  
Rancho wash just before  
reaching the edge of  
the Canion. The limestone  
at the base of the Pliocene  
group rises to the east and  
with 

outcrop butts are unaffected  
by the uplift. It is a local  
area of disturbance. There  
are other indications of  
disturbance but too slight  
to be determined as local  
etc.



(1st  
Ceph)

*h. Impure limestone*  
holding cast of fossils  
and also in the pure  
limestone will preserve  
shells. Gasteropods brachi-  
opods and lamellibranchs.

Red mud 4<sup>11</sup>/<sub>2</sub> 6

15<sup>11</sup>/<sub>2</sub> 40

*i. Impure limestone with  
indurated gypsiferous  
shale beneath.*

*k. Red gypsiferous shale.*

*j. Impure limestone slaty*  
beneath (see pg 58) 2<sup>11</sup>/<sub>2</sub> 10.  
White mud 2 feet with  
or below (red) 70

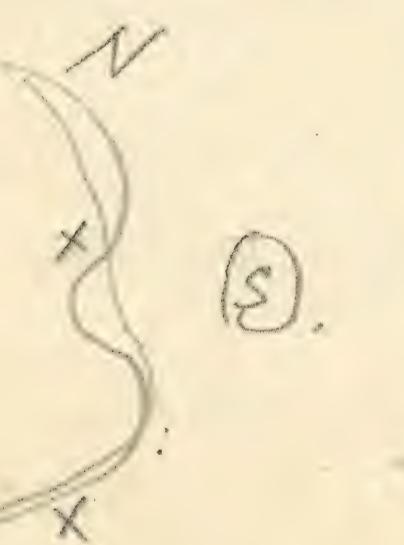
Far west side is composed of thin  
gyp mud & mud alternating  
Solid on Butte in west slope

The limestone capping the  
low cliffs south of the Shinnecock  
conglomerate on the west side  
of the Hamlet wash, extends down  
to the western margin of the  
cliff indicating a fold and

w - - - - -  
w - - - - -  
f - - - - -  
farther as the Shinnecock  
Conglomerate.

The general dip of the  
undisturbed strata is

steeped from southwest to  
south the slope is seen  
to be the western end of a  
synclinal anticlinal arch.  
The entire structure is as  
follows.

On the west side of the  
Kewal wash just before  
reaching the mouth of  
the Cañon. The limestone  
at the base of the Shoshone  
Gp. rises to the east and  
north -   
outlying buttes are not affected  
by the uplift. It is a local  
area of disturbance. There  
are other indications of  
disturbance but too slight  
to be determined as to diff.  
etc

(1st  
Cnch)

Shin Gh.  
disturbances

"Junk" - translate abroad  
Land of Lower Kandahar

the low, undulating limestone land.

On a. the valley sides the ditch extends  
across the valley bottom, cutting across a  
gravelly bar at a distance from the river.  
To its east of course follows a series of  
small ridges of alluvium, which follow the  
valley floor for a long distance across the valley.  
The valley floor is composed of the coarse  
material of the stream bed.

At the south end of the valley the stream

turns south of the stream  
is broad and with the exception  
of low valley bottoms which  
is limited to the wash  
is several miles broad and  
it is cut in to the carboniferous  
crystalline rocks which it  
is watched as far as the  
line of sight. A few  
mountain tops appear, one  
so far to the south so the  
north the rim is the high  
rim of the hill. The number of  
cliffs present a bold and  
bold. Headlands & marshy ground  
having deep canons that add  
to the varied surface by fronting  
the wide rim of the terrace  
cliff. Below the low cliff is  
the plain of conglomeric  
capped with white flint jets  
in great lines of ~~parallel~~ patches  
headlands. On the south  
butte looking like a granite  
in character, though

page 54. rest on the moderate surface of the red shale belt. This is well shown in the outlying buttes on the east side of the wash south of the cliffs.



It varies in thickness from 10 to 30 feet. Contains many fossils, the upper portion is a sandstone holding lamellibranch shells. 1/2 mile N.W. the limestone is not over 1 foot thick but a thick band of gypsum & arenaceous shale replaces it. near the base a few thin sandy layers 2 to 6" thick hold lamellibranch shells.

The fossils occur in the limestone, sandstone, arenaceous shale with gypsum, laminated layers alternating of gypsum & sand & argillaceous shale. Impure argillaceous limestone with fossils replaced by gypsum.

A section on the west side of the Knob wash taken from the base of the Laramie Conglomerate.

The upper surface of the shale was eroded prior to the deposition of the overlying conglomerate as may be seen in most good exposures of the line of contact of the Conglomerate and shaly sandstone.

The entire section was carefully measured with the exception of 75 feet of the lower red shale.

the conglomerate at the point where the section was taken is darker than usual and in fact is a very dark rust color for a mile or more along the exposure at the lower beds the upper in many places being nearly fine white sandstone c.b.

The pebbles are all agatized. No fossil wood was seen at this point.

c.s.d.

Shaly sandstone, dark reddish brown passing 20 feet from the summit into a massive sandstone. Ripple marks and wackes occur in the shaly portion

135

This cabin c.s.d of section (shianamp).

2<sup>nd</sup> Dark red arenaceous shales with veins of gypsum.

unifying the it, both horizontal and vertical 135  
c of section.

3<sup>rd</sup>

Gray gypsiferous mud, arenaceous, with bands of red color near the base 125

4<sup>th</sup>

Red <sup>calcareous</sup> arenaceous gypsiferous mud, odd sandy bluffs not indicated near the summit 110  
Measured 225 feet  
estimated 75 by bromstein & dip.

5<sup>th</sup>

Impure limestone holding fossils. Gypseous at the joint

i 1

Red gypsiferous mud 15

6<sup>th</sup>

Shaly impure limestone varying from 2 to 4 feet

with arenaceous gypsum  
beds beneath. A few of the  
sandey layers increasing to  
7 or 8 ft in thickness and  
holding fossils a band of  
red mud separates this from  
a somewhat similar shale  
and limestone beneath.

On an outcrop little on  
the east side the white  
band is limestone the  
lower strata being fine  
limestone (in thickness) 25.

The last bed is becoming  
thicker as it rests on the  
inner surface of the  
gypsum sandstone band.  
Which shows erosion.

Section contained a west  
ridge.

3 Red gypsum rock  
with brownish shale  
below. Few bones found  
near summit 108

4 Yellowish sandstone with  
red gypsum rock shale  
beneath 45.6 ft 37

10 chocolate colored limestone  
containing casts of fossils  
and also a few faintly  
preserved specimens 15 to 25

11 cream colored limestone  
with red fossils in  
upper portion. Small  
chert nodules 25

12 cream colored shaly  
limestone 32

13 Limestone gray to yellow  
with much chert 31

14<sup>th</sup> Cherty limestone chert  
is large, massive, with  
big black.

Contain numerous  
fossils. *Pseudostrophe Atypia*  
etc.

85

Section of the canon wall. Back  
side at the first alkaline  
springs.

\* Cream limestone with red  
ferrile ll. of ferruginous section  
flanking the summit of the  
cliff at this point. To the massive  
clerty limestone the slates  
are much broken up by  
irregular bedding. The  
ferruginized sandstone and  
the irregular distribution  
of the chert.

150

Massive bedded cherty  
limestone

200

A fault crosses & + 3 and the  
section was discontinued.

2-5' white  
200' 10' 2'

66

Section of cliff below Shinnecock  
Cove.

1. Red fossil bed with  
characteristic fossils caps  
the cliff. Beneath this the  
beds recognized to the north  
as limestone with sandstone  
bands are 4/5 arenaceous  
rock with chert + some  
limestone 200 feet

2. Marine cherty limestone  
beds - 100 feet by cliff.

North 1 mile.  
An indurated brown sandstone  
caps the cliff back from its  
edge a short distance.

1. Cherty limestone with  
large proportion of sand

2. Marine bedded cherty  
limestone 150 250

67

Base of red bed	4950
Top of red bed	<u>5725</u>
	875

Limestone with Calciferous  
nodules in layers intercalated.  
70

Top of limestone	5995.
Base	<u>5725</u>
150.	
70	Quartzite bed
270	250.
25	Calc. bed.
245	
49	

Top Dym bed 2.4 — 6100  
125

Gypseous sh. 125

shaly limestone. Yellow tan  
to gray & up to cherty. 65.  
Holds many fossils -

6200

Marine Chert bed	<u>6300</u>
Top	6425

+ 2 ft chert bed	225
	<u>250</u>

more + continue you a

65

125

77

Section  
Cana.

1. Red fossil  
characteristic  
of the cliff.  
beds occur  
as thin  
bands in  
rock with  
limestone

2. Marine  
beds.

North,  
an island  
Cape the  
edge a sh.

1. Cherty  
limestone

2. Marine  
limestone

3 Cherty limestone thin  
beds passing to calcareous  
sandstone and yellow  
sandstone. Holds  
fossils in *Calcareous*  
*pentium*.

3  
Gypsum bed with  
alternation of pinkish  
sandstone

4  
4 Cream colored limestone  
passing down laterally  
to arenaceous limestone and  
to sandstone. (Cherty) 85

5 Sandstone with light  
gray, with cast of fossils (Cherty)  
Producster etc 140

6 Light colored sand with  
calcareous layers. Between  
with somewhat thin  
layers than the mass  
stone containing some

68		
sandstone.	45	40
d.		55
Gray c.t. sandstone	30	*
5		245
Deep red pinkish sand with shaly friable partings	235	*
6		
Pinkish c.b. dark red sd 20 or 30 feet passing into evenly bedded an- d above	230	
7		
Layers of gray sd followed by somewhat massive st. st. separated by pinkish shale (dark red)	250	
measured by Farnham + Dev. Locks loc. each gave 175.	175	
8		
As a way a c.b. gray sd as an aphelite Chl. con- text.		

69

Secton of massive c.b. carboniferous  
4 miles below.

6. Massive bedded c.b. sd.  
L. L. — — — 315.  
This is a variable bed in  
color. Just after it makes  
its appearance in the canon  
the upper stratum is gray  
to buff with deep red partings.  
The massive beds of a  
grayish hue and again  
reddish. Five miles below  
the purple predominates  
at the summit smooth gray  
red + buff below. It is a  
great mass with out any  
regular division in color  
or stratification. Near  
the summit a stratum of  
shaly limestone is inter-  
calated at one locality  
for a few hundred yards.  
This is also replete at

70  
at the central portion &  
some c.b. strata are  
somewhat calciferous.

as a whole the gray-green  
predominant at summit  
then buff followed by  
purple and reddish layers.

7 Alternating purple and  
reddish bedded sandstones.

Rock colors may be present  
in same band as layers.

on a band of 20 feet may be  
purple & further on reddish.

Sandstone occurs in nodules  
& also in shaly partings  
with friable sandstone

The more massive beds vary  
as to thickness, the c.b. and  
color.

8. 2, 16

B - 150.

9 Gray c.b. ad. upper surface  
somewhat irregular.

72

71  
8.6 Purple ad. but tally c.b.  
with  $\frac{1}{2}$  shaly limestone  
at the top. 25

9 Mainly c.b. buff colored  
ad. 38

10. 2. 9. 155

B - 150

9 Purple sandstone, mar-  
gin c.b.

10.

Note for 2. pg 66:

A careful measurement with  
lock's level gives of the massive  
clay bed on the east side 2 miles  
east of the section a huge 66  
gave 265 feet for the massive  
but this included about 15  
feet of the lower <sup>and</sup> clay beds  
which were included in the  
beds below. The tonometer  
gave 250 feet.

Note on 3. pg 67.

Near the upper horizon  
there are several pink,  
slightly limy andaceous  
layers 2 to 6 in in thickness.  
Lamellibranch shells occur  
as on west side.

At this point I will below  
show on east side  
the same beds. Top of massive  
massive clay, is a a lens  
with the base 150 feet on

the west side. As seen with  
lock's level.

The limestone beneath the  
gypsum bed is somewhat shaly  
for a few feet but rapidly passes  
down to the thicker cream-  
colored magnesian limestone.  
This is more sandstone on  
the east side and the mass  
as a whole is thicker by 80  
feet than the same on the west  
side.

74 Oct 22d 79.

1/4 mile above mouth of Kanab  
Canyon on the Colorado.

1 Massive indurated red  
greenish ferruginous.

20

2 greenish micaceous <sup>an</sup> shale and  
passing up into calciferous  
sandrock and to mottled  
gray limestone (shilks) 30

3 greenish arenaceous and  
micaceous shale (shards) 115

4 gray limestone alternating with  
arenaceous shale  
passing into mottled limestone.  
Passage beds to the mottled  
limestone 70

5 Prismatic trilobite beds  
& coralline wacke.

Lake Knob Canon, westward  
3 miles from the Colorado.

1 Calciferous sandrock at top and  
base, buff sandstone between.  
This weather black and will  
be stained a reddish hue by  
the wash from above. 35 feet

2 Gray and dark colored lime-  
stone, rather predominating to  
very hard, little breaking  
into angular fragments.

The gray limestone looks  
hard if it occurs at all levels  
and there is no sharp  
mark separating it from the  
limestone. The gray limestone  
is in layers of varying  
thickness, up to a foot. Usually  
extends many or all parts  
of a section. The upper part  
of 55 feet to the first, only  
partly fossiliferous.  
Limestone and limestone.

thin micaceous sand occurs  
at the summit. The lower  
band of is especially a  
reptile of the apl. in  
lithological character &  
the same trilobite bed  
was observed in each.  
The corals & molluscs  
occur in the lower bed,  
chiefly, tho' seen to the  
summit.

This band is a portion  
of the Tonto group and  
comes the Pennidental  
up to the sandstones.

It is broken up into several  
bands by shaly partings,  
usually arenaceous, and  
again subdivided into  
thin micaceous sandstones  
etc.

Upper bed	85.
Carter " "	295
Lower " "	70
	450

3 Greenish micaceous shale  
micaceous shale and a  
few layers of gray sand-  
stone passing up into  
arenaceous limestone below  
of preceding 150.

Add section  $\frac{1}{2}$  mile up the  
Colorado. See pg 74.

Found Trilobitic remains  
Lingula and Hyolithid  
in 3 also in base of (2).

Starts about of Cenozoic. Top of  
base division of limestone (2)  
at 150 + does the Colorado.

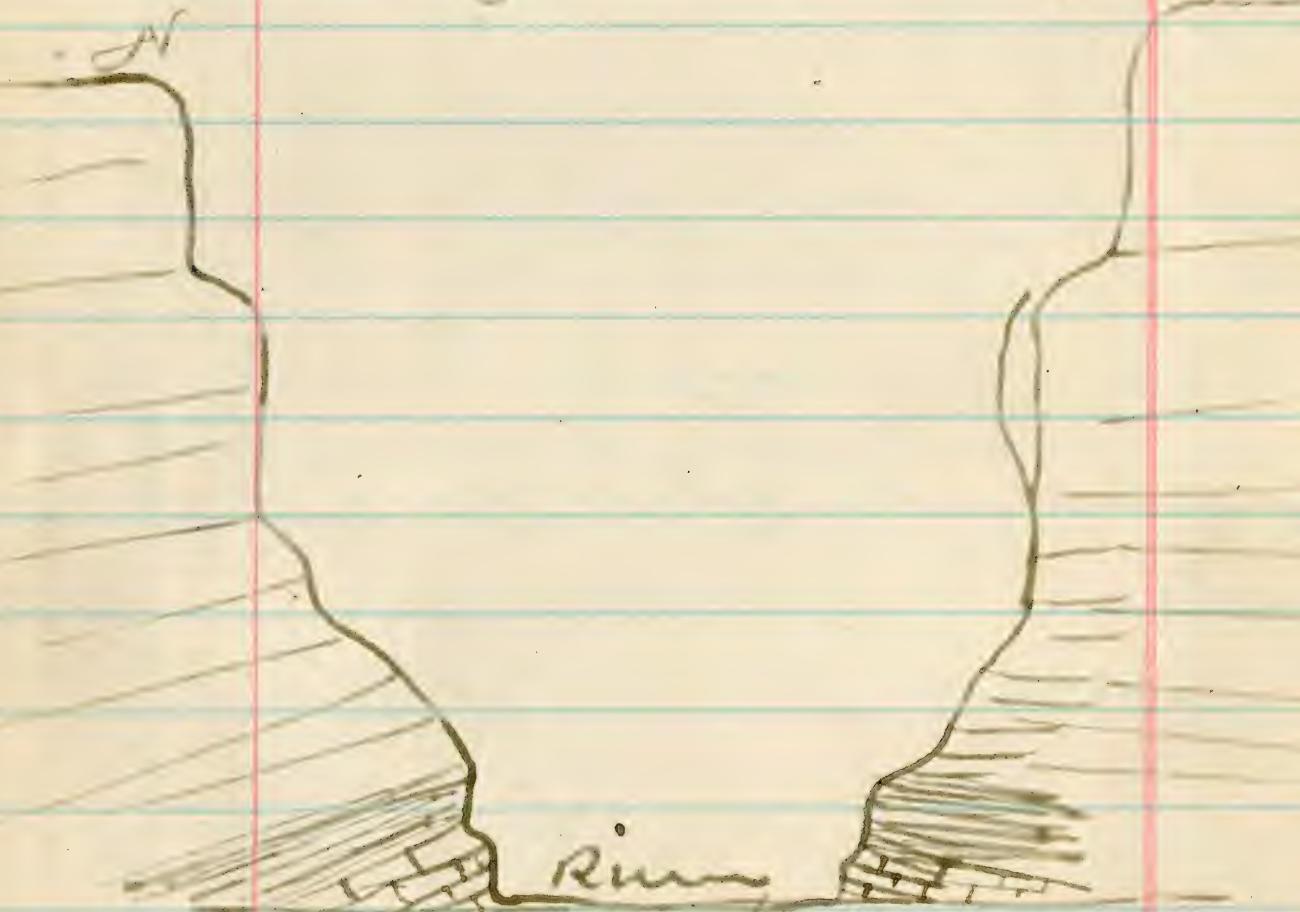
2<sup>o</sup> The calcareous  
the hard sandstone at  
the base of the Tonto group  
rises to the A.E. going up the  
river above the mouth of the  
Great Colorado about  $\frac{1}{2}$  mile  
where it rises but above

28.

just below  
the water and at the mouth  
of the Kunkel canon it bows  
beneath the water line.

A half mile above the start  
on the north side dips 15° to  
the N.W. & on the south  
side of the river 12° to 15° to  
the S.E. The higher strata  
(limestone) do not appear to  
partake of this strong dip

S



local pushing out of  
strata at base of cliff  
walls.

29

Part of section on the east  
side of the canon about 3 miles  
from the Colorado. Oct 27"

1. gray (light) limestone, resting  
on weather-banded cherty lime-  
stone. A coarse fossil search  
did not show any fossil  
remains that could be  
identified as such.

85

2. ~~Brachiostone, friable, stained  
purple, with a few lime-  
stone layer in the central  
portion~~

35

~~3. This band of sandstone  
forms a cliff which  
extends all along the  
cliffs on each side of the  
canon & also the Colorado  
canon above its course  
the washes cliff.~~

3. ... no.  
gray limestone and  
sand as 1.

35

7. Imp. limestone, arenaceous  
in places, with masses of  
calcareous gray mottled  
with purple. Uniform gray  
on weathered surfaces.

90 feet from the point  
the gray limestone again  
predominates and continues  
down 90 feet & becomes  
more arenaceous than  
preceding 25 feet.

185

5. Gray and  
Imp. limestone passing  
into buff sandstone with  
open subhorizontal layers

55

- Below limestone (2)  
pg. 75.

The mottled limestone  
occurs near the base of &  
the purple mottled limestone  
irregular relief.

the main bed  
is thick with intercalated  
shale layers and collected of  
fossils from the same. They  
have a subcarboniferous  
aspect

145

The sh. th. is in layers  
of irregular & irregular ran-  
kifications coincident with  
the bedding & forms about 1/4  
of the mass. Fossils occur  
in abundance near the  
central to upper part. Below  
none were seen.  
Spirula, Orthids, Ceratites, Bivalves  
etc with many species of  
bryozoans occur.

Thickness of bed 145.

This bed beneath the  
massive gray limestone  
the shales are megalodon

Oct 31 1919.

In coming up the canon  
noticed several illustrations  
of the erosion of the Chouteau  
beds & the deposition of the shale  
etc. prior to the deposition of the  
limestone also local con-  
tacts of the upper portion of  
the hill in strata.

Reexamined the chert bed  
three miles above using a line  
125 feet + 75 feet by pocket level.  
= 200 feet. There were not  
as many fossils at this point  
as below & the proportion of  
~~limestone~~<sup>chert</sup> is less than  
in previous section. The  
chert is light colored  
weathering blacky

~~in~~ & the massive lime-  
stone above the chert bed  
near where the Laramie  
spills into Arizona

The upper portion 250  
feet was measured with socks  
level. The remaining portion  
with the line & a chart dis-  
tinguishes with the level.

~~'shaly' limestone with pink  
chert and intercalated ana-  
naceous layers~~

255

~~massive light gray lime-  
stone with some finely  
bedded cherty layers near  
the summit. also at 200  
feet below a band of cherty  
layers intercalated with  
the limestone.~~

487.

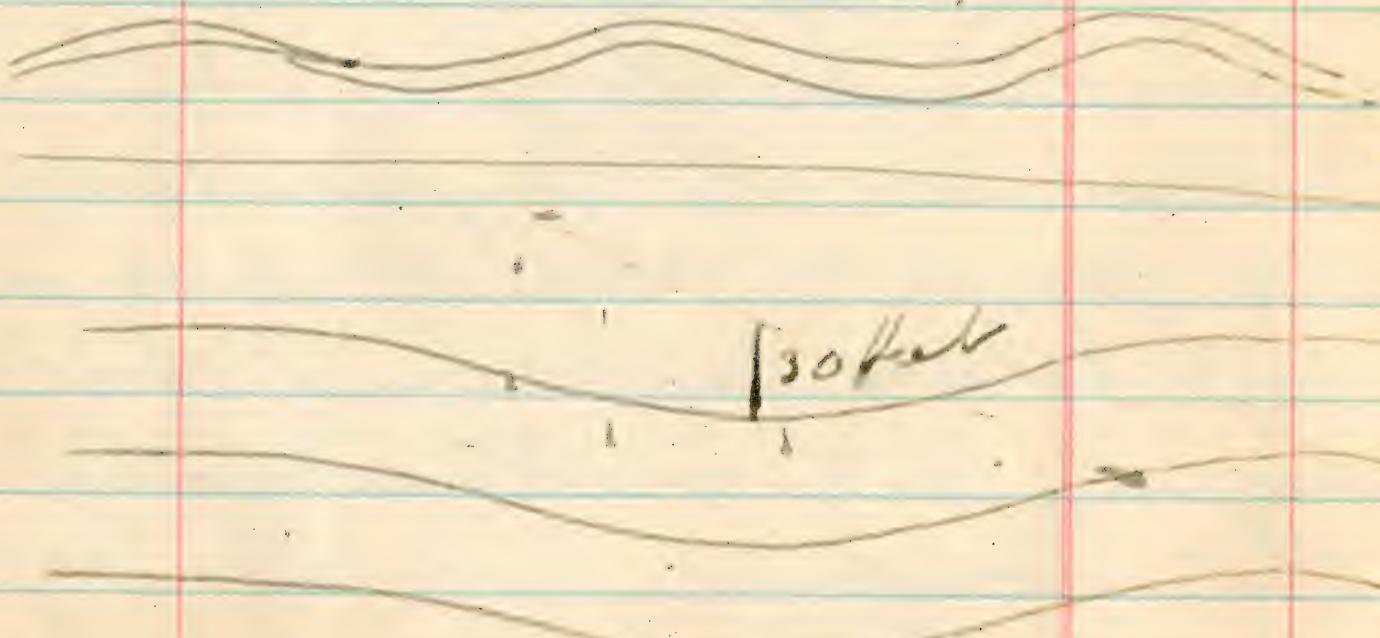
~~Fossils were found at various  
horizons but none abundantly  
near the summit. A species~~

84

of *Syringopora* occurs in great abundance in the form of casts of the stem structures at the base.

Another section of this bed was taken two miles further up the canon, all but 75 feet (measured by line being taken by books) and 477 feet was obtained.

The upper layer of the limestone. (the two upper bands) are very unevenly bedded forming undulations.



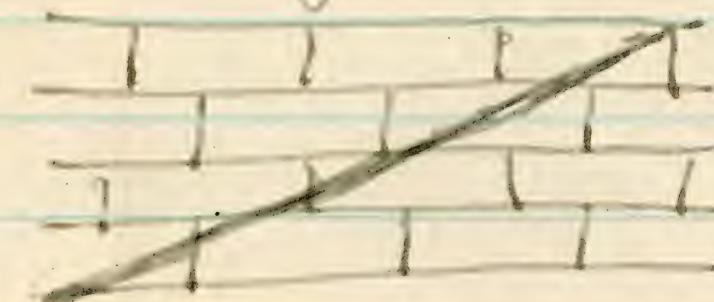
This irregularity is not  
above the bed above.

85

so that at the base of the purple sandstone the coralline is restored.

The mass is light gray.  
It is usually divided  
in fine massive bands  
which dip gently back  
into several thinner  
bands. The upper cherty  
bed is not persistent,  
the being about of the  
limestone uniform.

Leaves oblique to the stratification occur in the  
limestone of the Carboniferous



Partial section Head of Canner  
in lower limestone, Lower  
Kanab Canyon, Arizona.

gray limestone with white  
chert passing into shaly  
limestone with pink or  
red chert and thin  
bedding marks alternating  
with thin bands of  
pink chert & shaly lime-  
stone.

300 feet.

The boundary both above and  
below of this band is very  
changeable. Below the upper  
surface of the limestone will  
cause variations of from 2 to 50  
feet. & above the pink chert  
may run up into the sandstone  
much further in some places  
than others. The purple  
sandstone above was 40  
feet in thickness where

the section was taken.

The first bed is a bed of  
fine white limestone to the  
sandstone.

The highest elevation  
of the laminated layer  
of the cross-bedded sand-  
stone that was observed  
is 27°. The highest general  
elevation is about 20° to 23°.



Local faulting in C. sand  
white band Cimarron  
Cliffs.

88

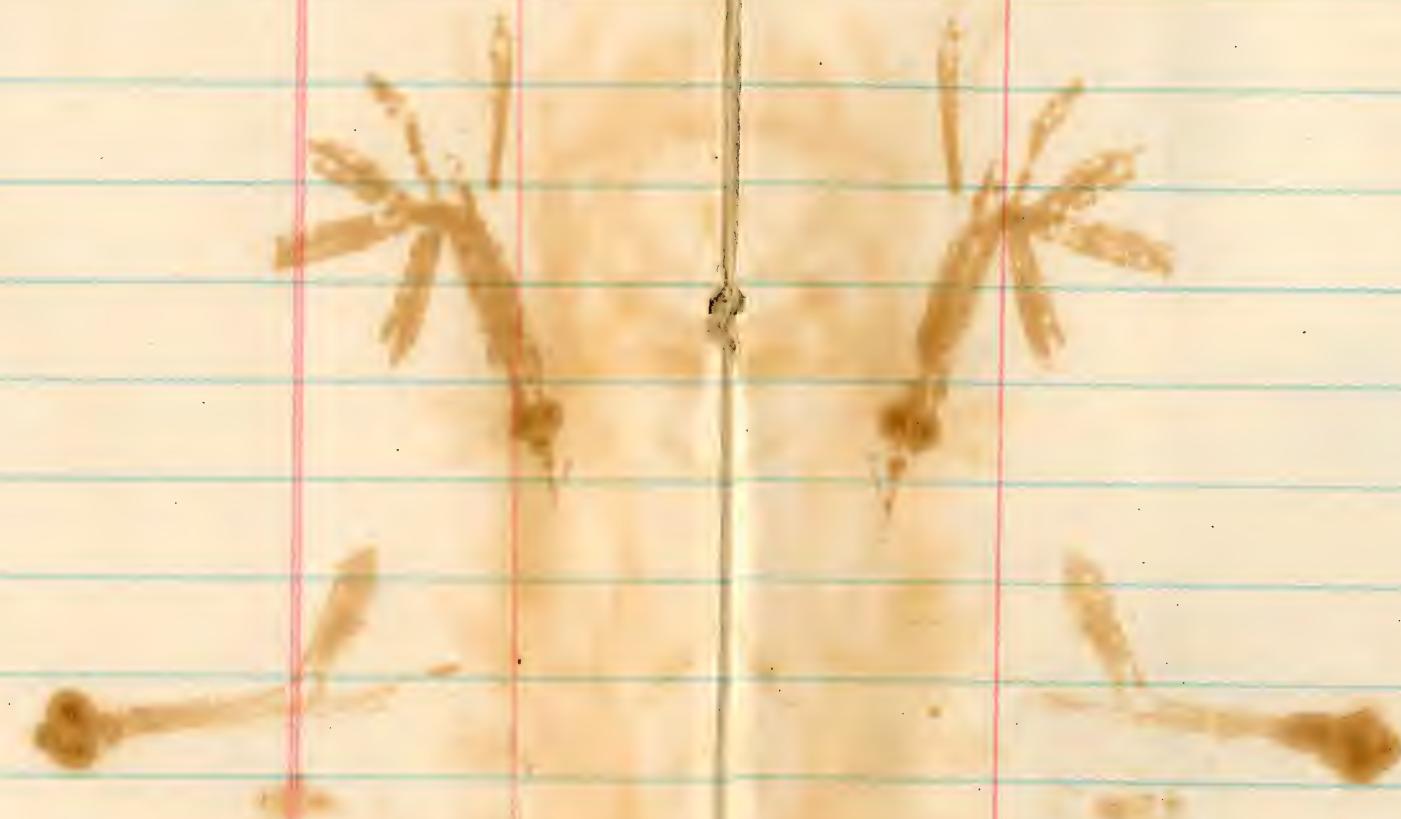
89

196

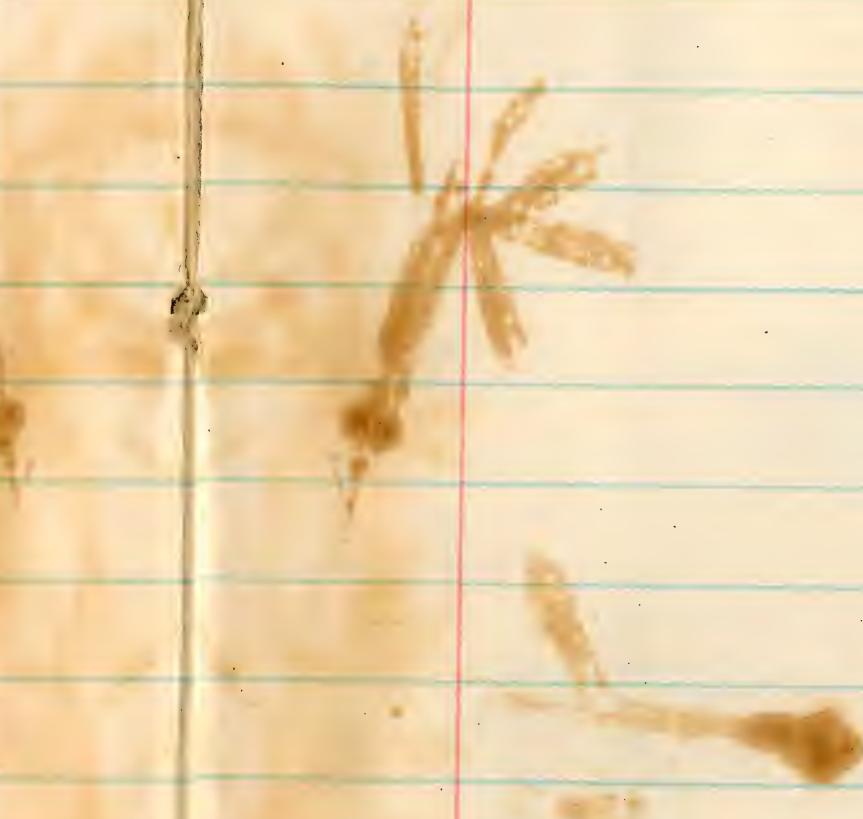
137



148



159





RU 7004 / Walcott  
Arizona Grand Canyon  
Field Notes 1879  
found between pp 148-9

Faults.

Pg 4. Fault in ~~the~~ <sup>151</sup> Canyon  
Kanab Creek. Pg

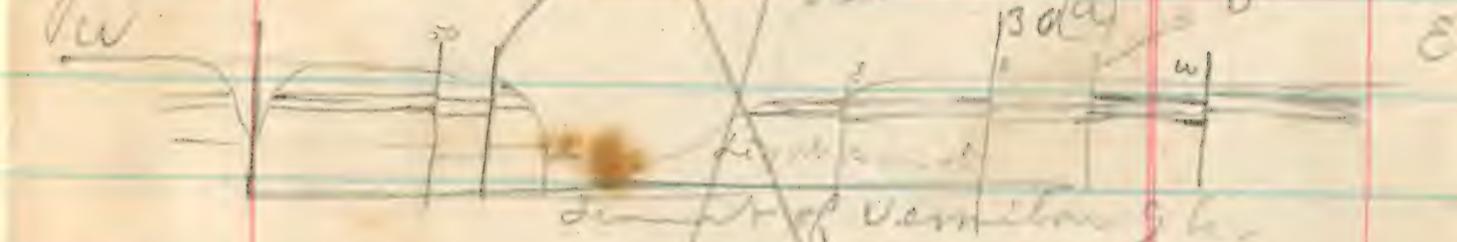
Pg 11. Fault 100' w of Kanab  
Canyon cliff.

at the mouth of the Kanab  
canyon in the Devil's Cliffs.  
A fault occurs on the west  
side crossing the spur that  
was at first thought to be south  
from the west side of the  
canyon just before it widens  
out to form the amphitheater  
about the village of Kanab.  
Site of fault SSW x N.W. with a  
displacement to the S.W. of 65 ft.  
The calicheous layer rests at  
the mouth of each basin  
below 1/2 mi (0) to the fault.

gray. I see all going down  
towards the red shale &  
light gray cross-bedded  
sandstone with the dip later  
and on the north side

of the spur there is a cut  
about 8.0 + 10' + here a  
dip occurs to the north of  
100 feet.

Crossing the Kanab canyon  
3 miles above Kanab there are  
two ravines one on the E & W side  
A cross section of the canyon  
tells the ravines get the  
following.



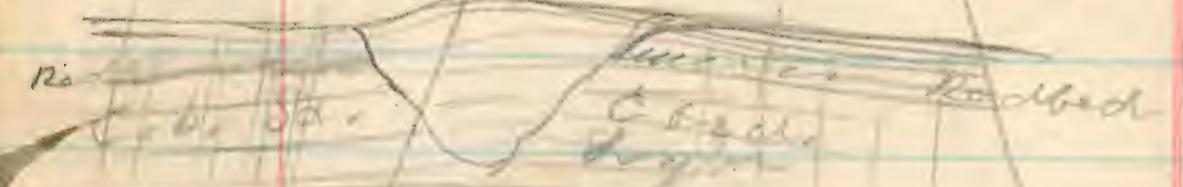
a section from the N side of the range as seen from 19 up the hillside that the side is elevated probably 50 feet above the west base of the sandstone. (a) consists at the same horizon forming miles)

(Roxanne)



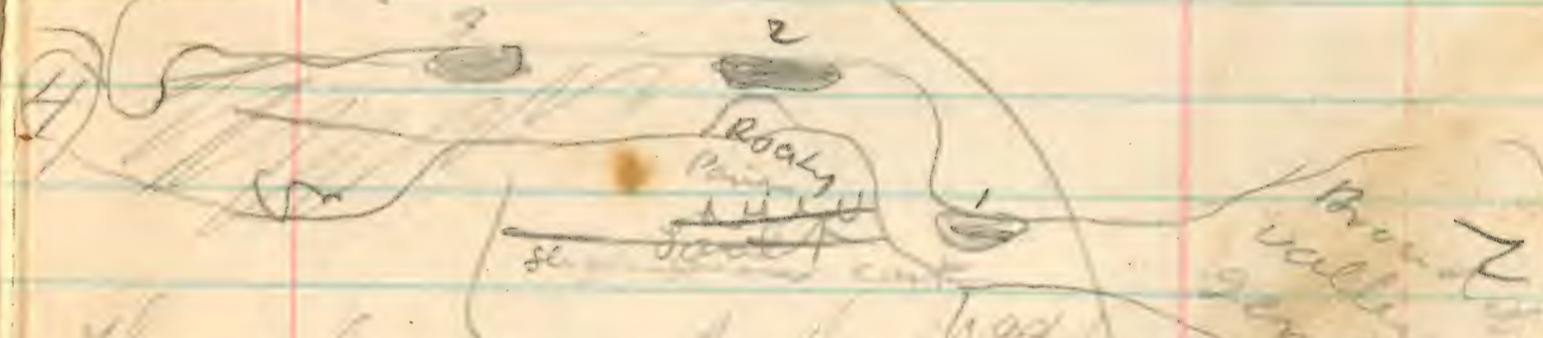
at the base of a narrow valley.

(Roxanne)



The ravine which the road to Long Valley passes borders to the west this has north, a few miles it a short distance down

the cones with a N. W. + S. E. line, with a drop of 50 feet to the right up the same divides. The West branch carrying the road to the North passes up apparently along the line of a slight fault. Higher up there are small lakes ocean.



The only great fault apparently left behind is ice. The lakes are small. No Deccans just before an abrupt turn in the road. No (2) lies against a small hill & is partially cut off by a low rocky bank running to the south. No (3) lies on the opposite side of the valley. The appearance of the hill is

1524

basket day below to the  
next tier of the rooms (W)

1525

On the summit of the lava  
2<sup>o</sup> 5' S. W. of Silverside place  
Kanab (Upper) Valley 8860 feet  
There is a cap of basaltic lava  
300 feet thick. On the west  
the top of the Pink Cliff limestone  
knee division is at the same  
level as the top of the lava.  
The strata dip North  $2\frac{1}{2}$ ° which  
out appears  $\pm$  to dip. It is on  
the west side of the fault running  
from the Pink Cliff uplift west of the  
divide at the north end of the  
upper Kanab valley. On the  
east the Cretaceous strata  
of the Larder coal division  
cross from the eastern fault  
on Dick & Kanab valleys  
up to the large canyon that  
leads up to the lava bed.  
The strata preserve uniform  
dip slightly north to the west  
& south until it passes beneath  
the lava. There is no

8825  
5750  
750 1-621

evidence of a monoclinical fold. To the north the Lenticular strata rise from the N.W. No evidence of its presence was seen on the land capped hill.

On the next knoll south buff sandstone outcrops with a dip of  $10^{\circ}$  N.W. 8825. No means of determining the position of the sandstone existed beyond the probability that it belonged to the upper division of the Cretaceous. There must be a fault east between this point & the Knob valley base point.

8575 ~~8825~~  
a little south and 250 feet lower the *Astrea* bed occurs in position dipping N.W.  $10^{\circ}$ .

Hill 75 x 250 x 320 feet

157

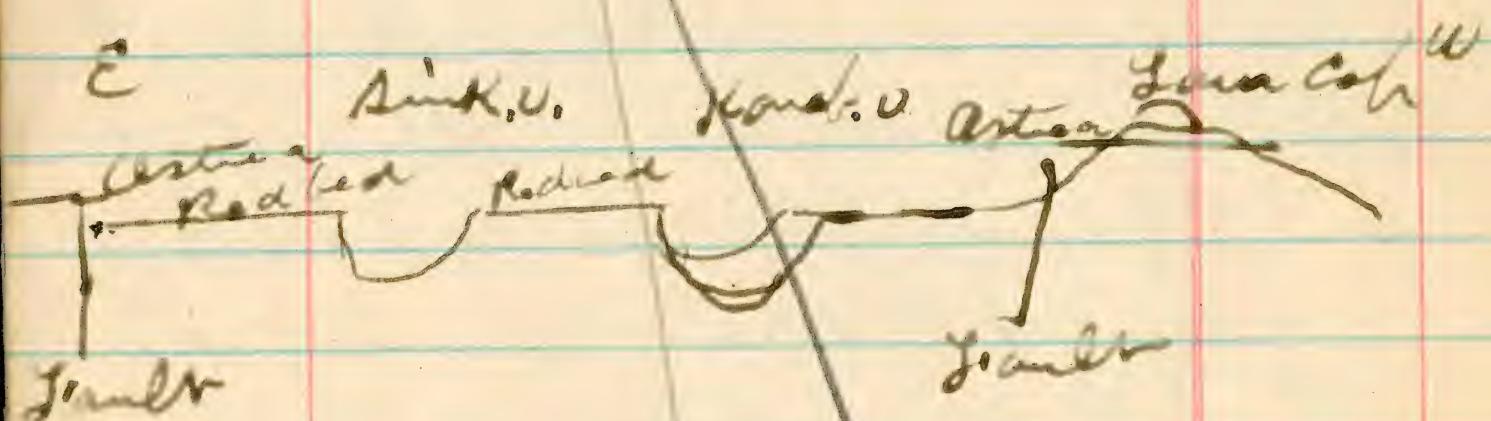
*Astrea* bed beneath sandstone on top of hill. This is a continuation of the dip & thickness measured  $\frac{1}{2}$  m. N. above the Lenticular bed with dipping  $10^{\circ}$  N.W.

The *Astrea* bed again occurs to the S.W. at a level of  $75^{8500}$  feet below the other outcrops & dipping N.W. exact dip could not be determined.

Also occurs again west along N.W. slope at 8450 sloping S.E. & again  $8350$  high hill N of Upper Volcano in valley below River. The dip here is  $30^{\circ}$  N.W. The rock is filled with the *Astrea* shells.

Westerly of large fragments of the *Astrea* bed and the sandstone underlying it occurs at different levels for 300 feet below on the

hill side towards the Cretaceous.



The Cretaceous strata dip to the S.E., rising to the S.W. The base of the coal series above the gyphipore monls is 7650.  
Thickness to Ortealed, 1230.

8880  
Down Ortealed                    8350  
                                      530.

530 = fault a lowest estimate  
as the Ortealed + associated  
strata dip N.W. 10° + the  
base Cretaceous S.E. There  
is evidently an upthrust  
towards the volcano the  
south of the strata west  
of the fault. From the  
Ortealed occurs + at

different levels<sup>159</sup> in the E. + W.  
line there are several  
small faults over the  
west side of the valley to the  
north towards the Pink Cliff  
uplift. The strata on the  
other side of the long valley  
canon are separated by a  
still greater distance  
to the west, or rather I would  
regard the Cretaceous strata  
as having been elevated.

The lava flow occurring on  
top of the hill points to  
the source of the disturbance  
especially as the faults are  
in a line with the volcano  
below.

The fault or faults crossing  
near from the Lava flow  
on the west side of the long  
valley above what is  
a cliff + sharp white +  
go south tho the long  
valley Canon.

the eastern, of the Kong  
or the divide separating  
the Cretaceous of the valley  
from the Tentary and  
Cretaceous N.W. of Little in  
the western hills over to  
the Long Valley canon.  
No evidence of a fault was  
observed in the Knob Canon  
white cliffs or in the canon  
east to the rd opening into  
Goshen canon. To the  
west no observations were  
taken in the white cliff or  
the long valley canons due  
off faults in that direction.

Note. From the base of the  
gray sandstone (sometimes  
conglomerate) beneath the  
Pic Cliff limestone to the  
arenaceous clays beneath  
the massive sandstone next  
below the latter bed above  
is a great natural group  
characterized by the predomi-  
nance of sandstones + clayey  
partings, in great minority as  
compared with the sd.

<sup>2</sup> The next division consists  
of clays + small arenaceous  
soft easily disintegrating  
liths extending down to the  
red bed or shale above the  
sandstones containing many  
fossils. This division forms  
low rounded hills and the  
extending southward to the  
right bank of broad  
sd.

162.

3. The greenish sandstone south gradually gives way to bands of shale & thin  
clays with coal extending down to gypsumous  
shales above Jurassic

4. The gypsumous clays  
& conglomerate pass  
to the Jurassic limestone  
limestone to white  
Cliff sandstone.

163.

Rotted bottom of cliff



Rock, south cliff  
12 mi. S. W. of Kona  
consists of a  
series of thick  
beds with  
interbedded  
calcareous shales.

1640.

Intervening strata west of the  
recently uplifted west side of  
Kaob Valley (upf.)

1	Cream Colored thin v.	50 ft.
1	White band	25 "
2	Pink (dark)	100 "
3	Cream colored sd.	50 "
4	Cream coloredhurst	100 "
5	Pink (reddish)hurst	
	Sandstone	150,

succeeding will south  
coupled with buff sd.  
such as occurs beneath  
the pink cliffs a strong  
horizon of sand  
occurs about one-half  
down.

300-

Just to the S.W. of this hill  
there is a hill of white  
precipitated lime. It is  
similar to the limestone  
strata the red band

165 166 167.

A small shell was obtained  
from the sandstone. No  
fossils yet observed in  
the limestone. —  
~~white limestone~~

Ad. dip measured to the N.  
white lust. s. w. 30° fold  
mon. The hill with  
white lust. may be associated  
with limestone. A dip  
to the eastward to  
a higher angle 30° to 40°. So  
high as far as examined.  
Going to the west end of  
the head of the  
valley above the  
white lust. sand  
is the only one of  
the others which  
is continuous  
and extensive. It gives  
a good exposure  
of the limestone  
strata.

Upper Karab Head of Valley.

The Pink Cliff run N & S across or north, the cretaceous running in nearly a parallel line far along distance just west N. & S of the old divide. Coming into pink valley on the South. The cretaceous is 2 miles or more in width across the divide. Is replaced by the reddish conglomerate which in turn gives way to the pink cliff uplift to the west of the trail over the divide. The cretaceous rock runs round south of the conglomerate & pink cliff uplift

No. of the divide. Most of the trail the beds are the same apparently as west of town at valley upper it may be seen

extending north for miles in the Sevin Valley. Rocks south & w of uplift (P. C.) have not yet examined

Sep. 8 " 1879.

South of the pink cliff uplift the sandstones beneath rise at an angle of  $28^{\circ}$  for a mile the dip is SW. W.

Elevation of pink cliff uplift 8925 feet. Still beneath remain the same dip  $28^{\circ}$  N. & and pass down through the limestone & beneath the pink cliffs to the upper portion of the cretaceous. The distance to the lowest outcrop in the valley is the 8 is  $1\frac{1}{2}$  miles. Elevation.

On the east side of this uplift lenticular limestone may be seen resting against the sandstone, inclined

at the point 17° of contact at  
the same angle but a  
short distance back it is  
reduced to  $10^{\circ}$ <sup>west</sup><sub>north</sub> & soon  
assumes the horizontal  
position E. & W. with a  
slight dip to the north.

~~N.W. cone.~~ Whether a  
~~fault~~ fault exists  
to the west was  
not determined at date of  
writing Sept 9<sup>th</sup> 1879.

Elevation of Lenting hill west  
of Bretaceous uplift ~~8500~~<sup>8500</sup>.

P. M. Left 9"

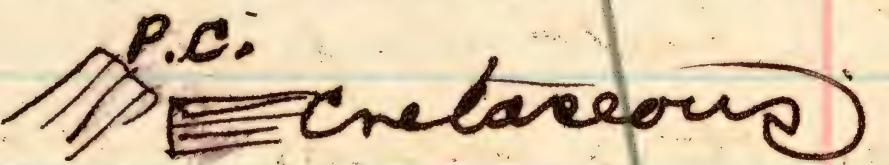


E + W section south of P. C.  
uplift.  $1\frac{1}{2}$  miles.

A faint synclinal  
is shown by sketches 1 + 2.  
When 1/2 miles west of Lenting  
Hill, the strata of the  
Lenting ridge dip  $20^{\circ}$  N.W.  
& the strata in the hills  
west 1 mile dip  $5^{\circ}$  N.E.  
The hills west are composed  
of limestone capped with  
sandstone & marlstone.  
A small ~~ridge~~ ~~butte~~ ~~is~~ ~~located~~  
~~slightly~~ ~~to~~ ~~the~~ ~~south~~. There is  
fair exposure down the  
valley west of the highest  
apex. The ~~ridge~~ ~~butte~~ ~~is~~ ~~located~~  
most exposed on the  
southern ~~ridge~~ ~~butte~~ ~~is~~ ~~located~~  
valley side.

Upper Kanab valley, West side  
8250. B. at 2.0. m. Sept 8. 79.  
The Pink Cliffs facing W &  
S.W show a slight dip to  
the N about  $2^{\circ}$ . The Cretaceous  
strata to the west have the  
same dip & the Astraea bed  
16.00 feet from the summit  
of the series of Cretaceous  
beds is a marked feature  
of the landscape. resting as  
it does 4800. feet above tide  
with the high Pink Cliff back  
feet above tide.

On the left the beds of the  
Pink Cliff of the west side  
of the valley dip N. at an  
angle of  $28^{\circ}$  resting against  
the Cretaceous rocks

P.C.  


~~is divided into several  
beds & separated by  
thin black bands~~

To the 173 west the  
strata have the uniform  
dip to the north and consist  
of lighter beds (apparently  
still cannot tell Col. in:  
white) capped with reddish  
bands. The Lyndale fault  
may lift the Pink Cliff in  
depress the white beds. In  
the reddish bed is capped  
with white limestone &  
miles west of Kanab  
valley (Upper). The summit  
of the Pink Cliff uplifted on the  
west side is 8925. 230 P. M.

Sept 8. 79 At little west  
of the road over the divide  
leading down to Kanab  
valley there is a mass  
of reddish colored carbon-  
ate, about 75 feet is exposed  
above the tide. It is  
the matrix is a reddish hard  
fine sand or argillaceous  
material & has embedded

174

in it fragments of pink  
limestone & sandstone occurred  
also small pebbles of quartz.  
The pink rock prevailing.  
The bed would appear to  
be made from the detritis-  
-tion of the pink cliffs  
limestones & ccl.

Barometer 8800. 4. P.M.  
Sept. 8. " 1879. Liph 5° N.

Cretaceous hill east  
9100. 4:30 P.M.

See sketch of valley &  
decide from this point.

Strata of reddish Conglomerate  
& pebbles of same extent  
195 feet higher up the  
hill than the summit  
giving altitude viz. 8800.

Asthenes west 8270 on line  
of seat south of Cang.  
sept 8<sup>th</sup> 1878

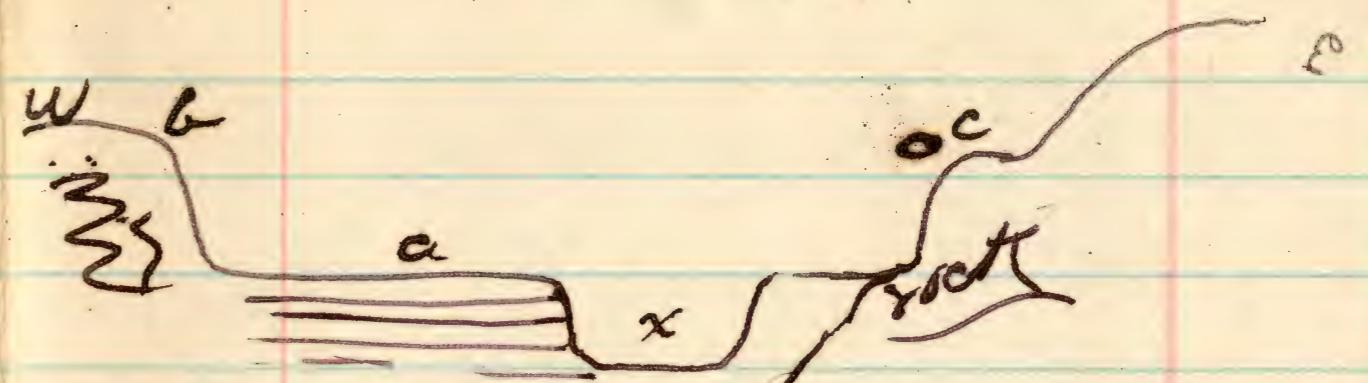
Ripple marks, tooth, evidence  
of lateral predation.

Ripple-marked slates were seen at various horizons in the Columbia River Group, Vermilion + white cliffs.

The man was back of crossbedded  
and tabular beds indicating fossilized  
currents & indicating bedrock  
in the water such a steep  
slope bed would slope up  
into water.

At this point there is a sharp dip in the  
cliffs. The limestone bed, about  
side ravine, the light-colored  
sandstone is tilted to the  
in all directions by successive  
of worn down to the yellowish  
filling weathered out. You  
can feel the rotation -  
I suspended the rock very  
near the top of  
the local stream.

The sandstones of the lower portion of the crossbedded reds of the W.C. gh., are usually very fossil when exposed to the weather at an angle to the interior. The general appearance of the beds is such that it appears that the currents lay down in the tide, down by the gentle current, such as tidal cement and then nearly strong currents tidal or stormy level off the bottom and formed a smooth form upon which the deposited a layer of sand which the type was again buried beneath the shifting sands which were once level off again etc., etc.



x Present bed of springs & stream of Kanab creek. Vermilion cliff a deposit of sand etc., evenly bedded & showing source of material in the red & light colored layers caused by the wash from the red and white beds alone. Height of terrace 35. (b) a second terrace of sand extending to the west at (c) the red sandrock has a grayish color probably owing to the upper terrace having rested against it. The lower terrace can be traced down the canon for two miles or more evidence of the upper terrace (b) is seen but a short distance.

In the upper part of the white cliff on the west side of the Kanab canon looking east it appears that the white cliff (limestone) is elevated about 100 feet above the western edge of the same canon. This must be owing to the fissure which crosses from the upper Kanab Canon S.E. to the Johnson canon on S.E. of Clarkston. The white cliff also has a slight dip N.E. from the Kanab canon, and runs to the long valley faintly to the Johnson canon.

No evidence of a fault was obtained at the mouth of the Kanab canon in the white cliff.

The lava flowing from the volcanos at the head of the canon by the white cliff

passes down the old canon of the Kanab valley entering the present road canon & flowing for a long distance on the east side, since the lava flows the canon has been worn much larger on the west side & the lava stands a black wall on the eastern side curving suddenly like a great snake down the canon following the old anagene channel of the stream that the canon. At the head of the lava stream the volcanoes divided the old valley into two water sheds one passing down thru the old drainage basin, west cutting the H. lava bed to enter the main canon, the other, passing over the channel down which the present river.

Save left North

11 a

Sinkt.

St channelopper

a but occurs at x. It may be small  
the one

does not show as well as at 11 a.m. No more

wide drifts

1947

178

Some drifts of sand - only a few

Lower bed in North. I  
have seen

1st

2nd

3rd

4th

5th

6th

7th

8th

9th

10th

4.0 M.

(2)

3rd Cont.

29

Pink beds  
as pros.  
red.

(a)

N

pink  
orange  
yellow

0

Pink beds  
as pros.  
red.

5

Seen from Sulek to the south of (1)  
The reddish beds at (a) rest upon & against the crinkled  
pink beds. The pink beds have however lower beds &  
the north. South the hills are wooded & the reddish  
dare not show as well as up here. See note of morning

white cutts

178

part of valley - east of Kerec -

Ephomite hillsdale the  
P. C. strata dip so west  
on the north side of  
the Etna canon.

See page 179. of note  
book.



1. Rock high & resting on wood deck  
outface of 2.
2. Pine cliff upper dip  $30^{\circ}$  N.E.
3. " " " 20° W-N.W. to  
bare limestone base bed.

Taken 6 miles south of Hillsdale  
from west side of sunrise river.

Nov 14 1979.

Gava

P.C.

Jan 20. 1900

C. (9.00)

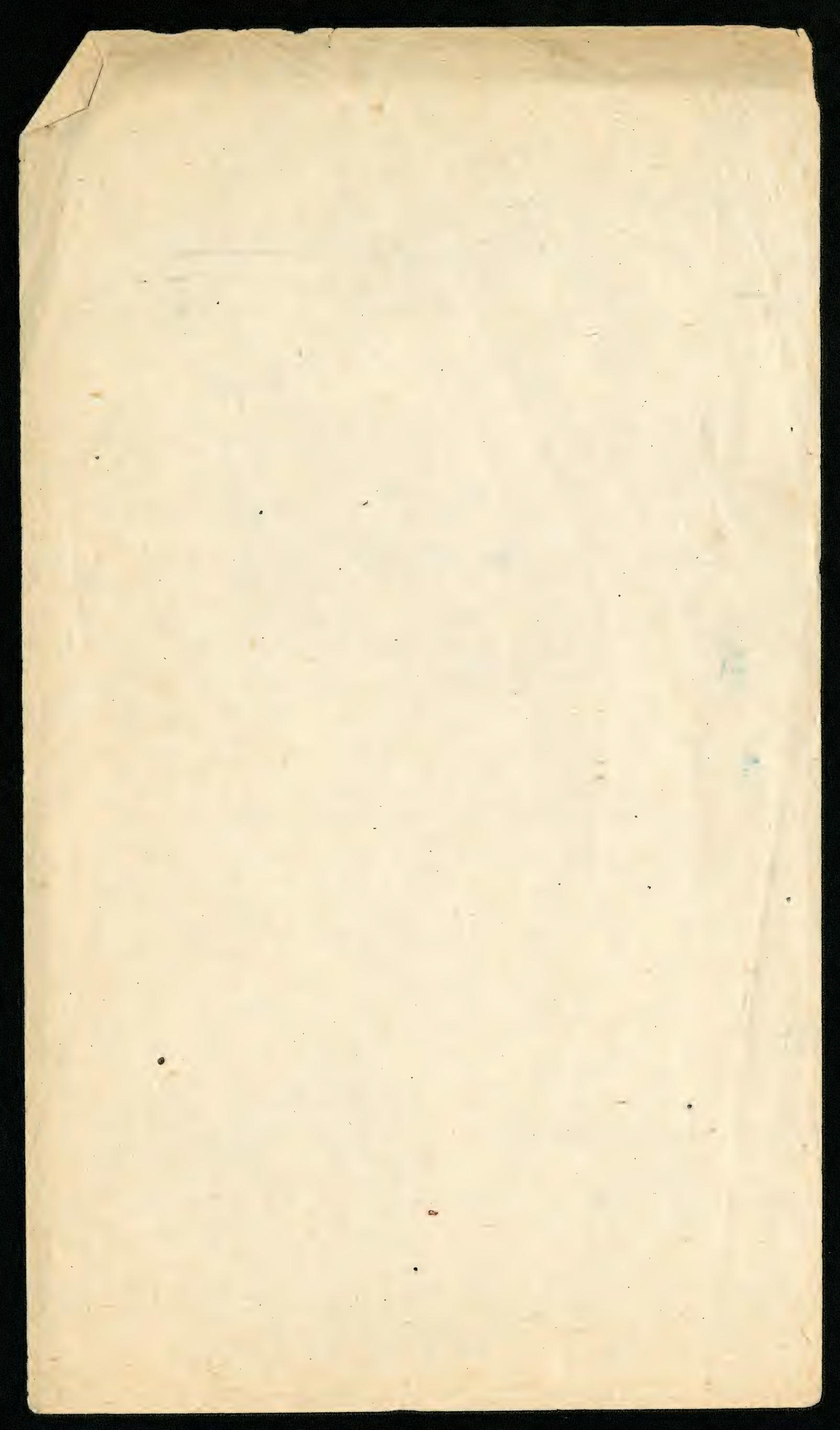
10

J. Rothko Kavel

Summit of Chesty Lush  
Knob Canon. Utah. Oct 6<sup>th</sup>  
(1) <sup>23</sup>

Viewed from the summit  
of the cliff west side  
300 feet above the canon  
bed. The strata of the  
upper 150 feet are seen  
to be mainly bedded  
and also cinned more  
or less in bands not in  
relation to any definite  
stratum but as tho' the  
bed upon which they  
were deposited was even.  
are dipping south.

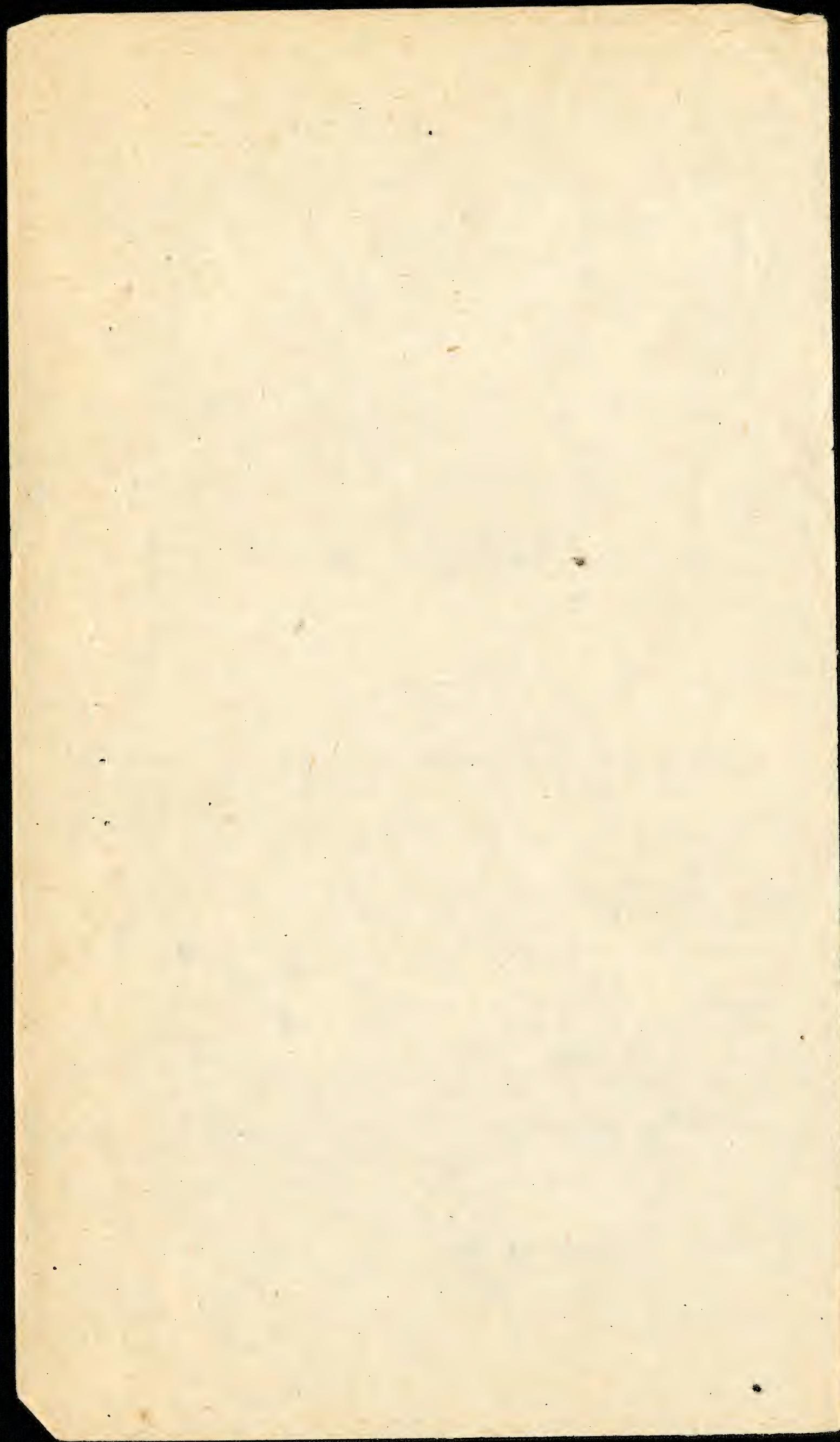




20

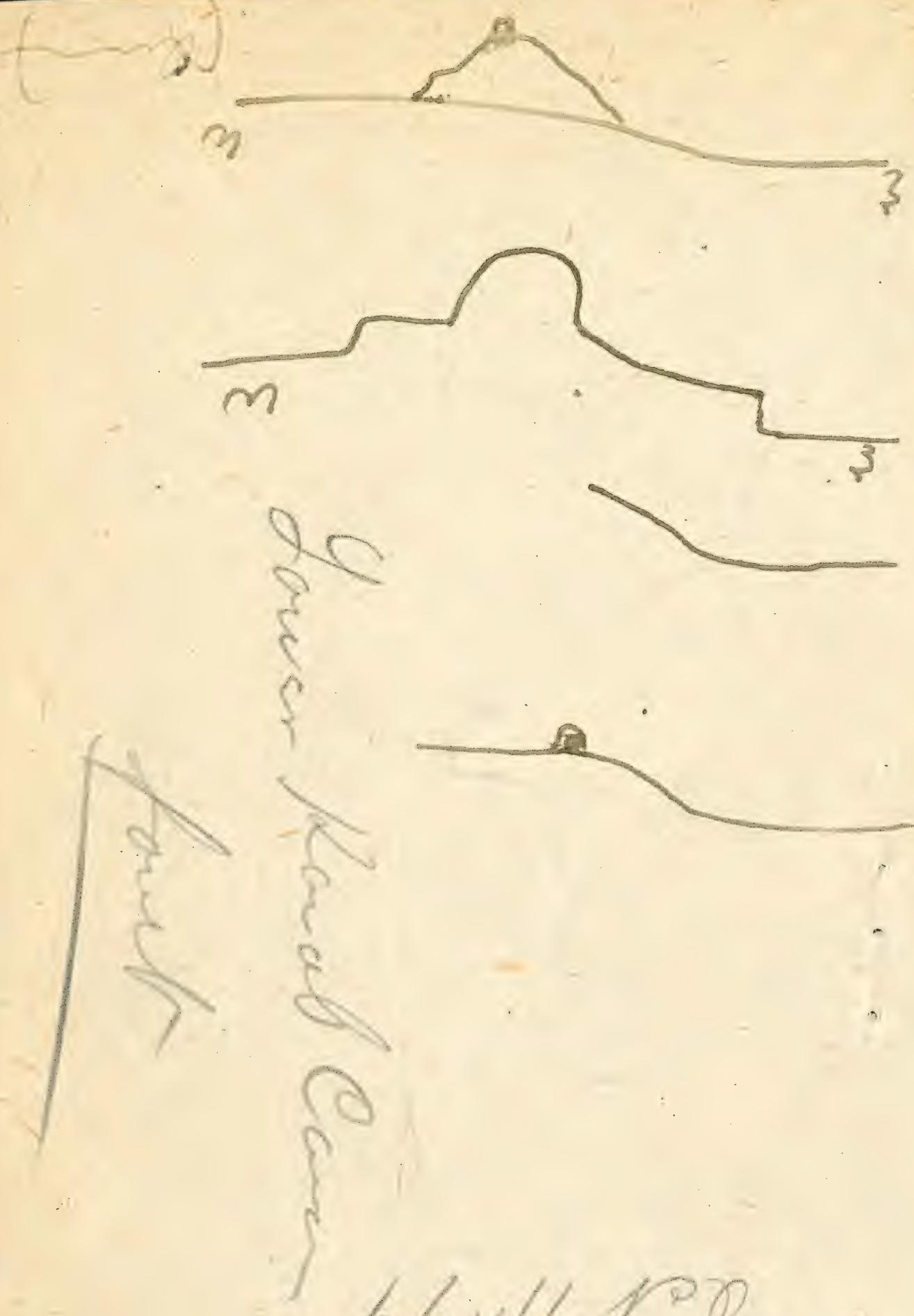
where the red bed makes  
its appearance above and  
below the left hand or  
east canon going down  
the fault is very plainly  
seen. The dam there is to  
the west and is over 100  
feet. The strata bend toward  
it from the east and incline  
toward the west slightly.





Silv.  
Inchameloqha

a part remains at x. It may be sandal  
stone



Lower Kankakee

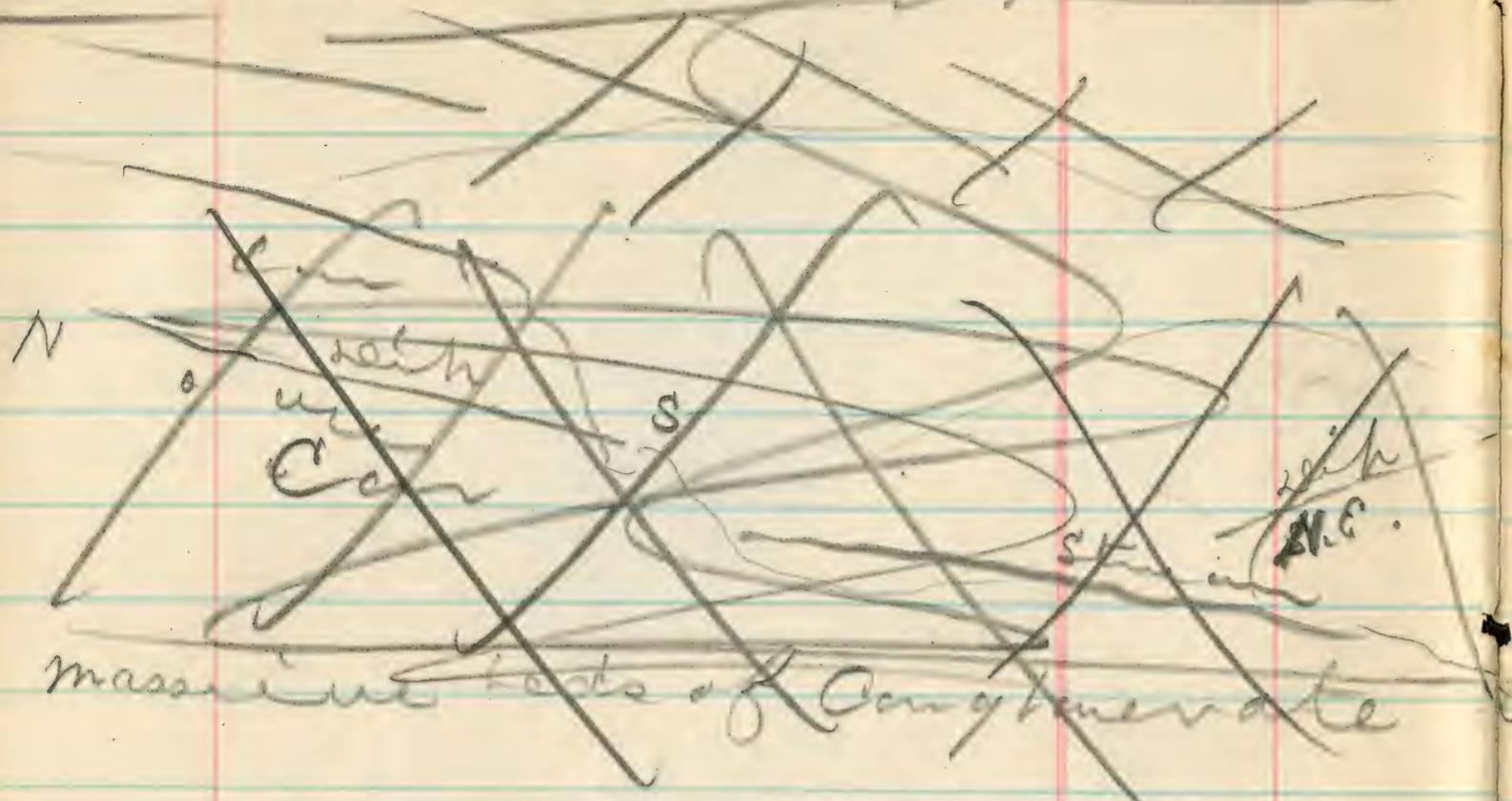
Lark

66,111 ft.

$$\frac{515}{575}$$

West side, red fossil bed.  
West side, black shales.  
West side, limestone  
beds same color.

~~Fremonts Pass Aug 7<sup>th</sup> 79~~



stream

1st Couth

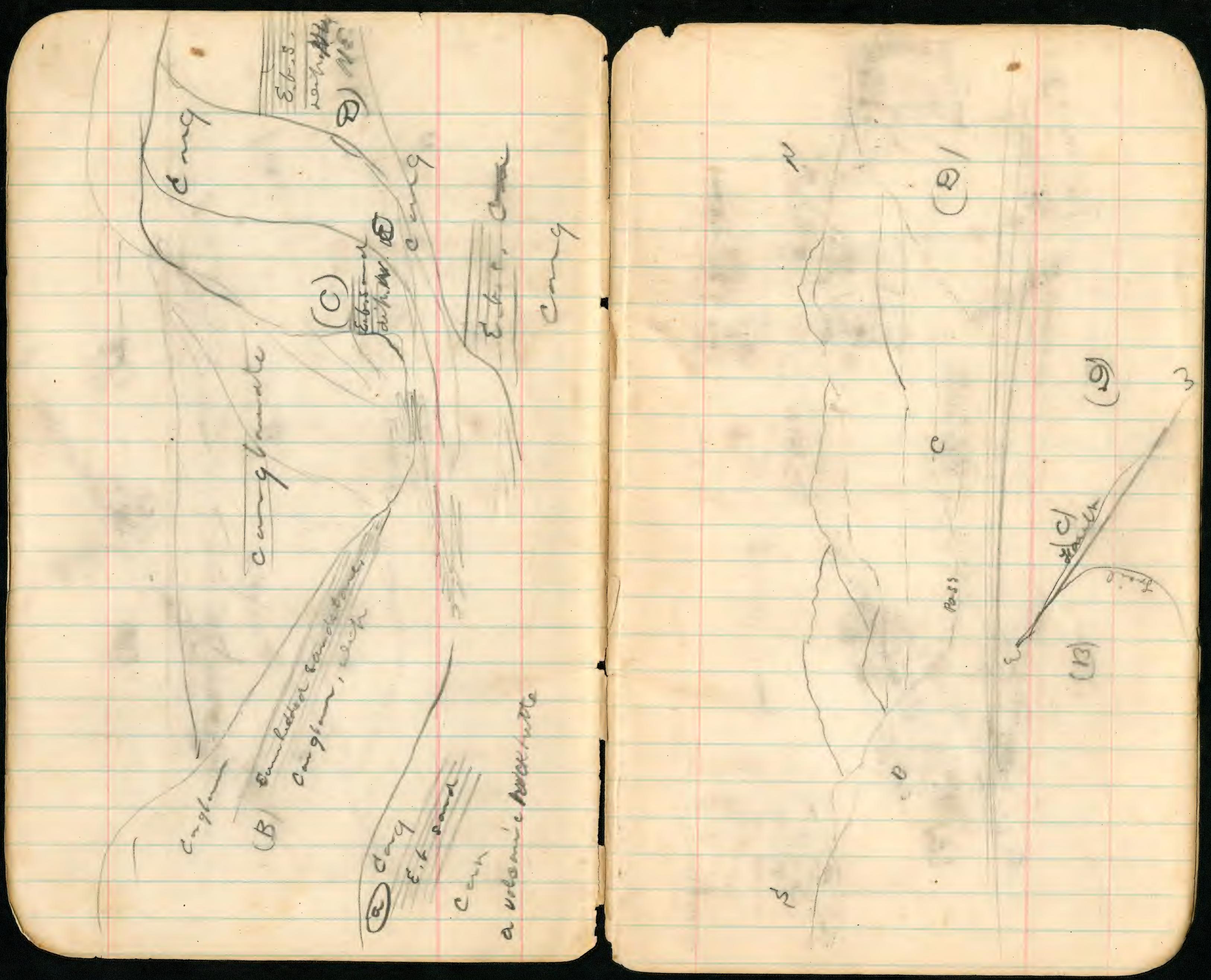
Tremont pass. Aug 6/79

South side, 5 miles up pass from  
the West entrance.

Base of section light colored  
thick bedded sandstone (?)  
with layers of brecciated (?)  
conglomerate intercalated,  
about 60 feet.

The conglomerate is composed  
of broken, angular, fragments  
of volcanic rock and larger  
rounded stones & some boulders  
of from 2 to 3 feet in diameter.  
The sandstone matrix is of  
medium hardness & where  
the broken stone are numerous  
gives the appearance of  
~~a bed of~~ ~~metamorphic~~ rubble  
work. Near the summit the  
sandstone is more of a yellow-  
ish color & is immediately  
overlaid by a thick deposit  
of volcanic rock (1). 30  
feet thick. This is evidently

an intercalated bed)  
The entire <sup>sandstone</sup> conglominate  
has the appearance of  
having been deposited  
rapidly. The sandstone  
being deposited and  
mixed with the products  
of volcanic eruptions.  
& the broken & rounded  
fragments of beds of lava  
etc. Dip of every <sup>bedded</sup> sandstone bed  
15° N. Above the coarse  
bedded sandstone layers there  
is a 500 foot of coarse con-  
this may be seen extending  
down the pass for several  
miles, if the dip is retained  
& the strike. A view from  
the opposite hill (Wendy)  
gives the following  
section.



at Pahranagat, Lincoln Co. Nevada  
Dr Remondy stated that numerous  
well preserved silurian fossils occur.  
Primordial, south of Egan and  
also 50 miles south of Fish Spring.

Wahsatch range & Sierra Nevada elevated  
at the close of the Jurassic. When pg 24. Y  
slight changes or late as the Eocene  
extreme

Wheeler Rept.  
sect III = upper half Kannah section.  
" IV = " " "  
" V = Lower " " "

Sect pg 270 = Kanab sect?

Received from Mr Bodfish  
1. Clinometer.  
1. Lock's level.  
1. Tape line - 50 feet.

Dan Bunker off 120 105 14  
51 19 38 85 95  
19 38 12 95  
38 182  
23 133 38 321  
158 323  
Sink valley .28  
Road 60 Mr. Loring 140  
85 12 161  
50 40 23  
5 235 735  
235 6000

Averoid, 225 13  
Rise to ~~the~~ 5925 -  
Aug 19". Basalt Barometric station  
5925 feet. 8 A.M. 4 P.M. in sun  
627 off Bill 6325.  
5525 250  
750 35  
85  
45-

Aug 23<sup>rd</sup> And at summit of  
white caprice ridge ~~100~~  
of the ~~100~~ ~~537~~ elevation  
at 9:19 - 23.05 - 5775- 10. a.m. 1  
at summit of Van Allen ~~5985~~ 10.30 - 2  
" " of red shale 6450 - 11.30 - 3  
top of hill  
at 1. p.m. 5850 2 x 1.m. 1

Nasini-Sao hink 241  
chin't head 150

Record of specimens  
Vermilion Cliffs.

## Conglomerate

30. ~~187~~ 187  
186 23) ~~187~~  
345 ~~187~~  $\frac{95}{102}$

## *Annularia* (Shivaramk.)

To fish bed from top -	250
Fish beds & frontier ss	100
To top of Shimamukh	<u>210.</u>
Shimamukh marks	540.
etc	350.
Estimate to top of conglomerate	350.

~~8800  
7650  
1150~~

Don Bunker's cliff 105 17 9  
~~19~~  
~~38~~  
 23 137 38 182  
 158 322 321.  
 Sink valley .28  
 Road to Mr. Lelais 170  
~~85~~ 40. 767 23  
~~50~~  
~~235~~  
 6000 13.5  
 5775 65  
 Averoid. 225

Record of specimens  
Demilean Cliffs.

320

Conglomerate.	17
62.00	5.40
3.0	6.0
2.0	9.9
6.45	66.
7.3	2.6
19	
231	
9.5	
105	

Aug 19<sup>th</sup>. Barat Baratti station.  
 5525 feet. 8 A.M. 4 P.M. in sunmet  
 of hill 6325. 250.  
~~6275~~  
~~5525~~  
~~6750~~  
 250  
 35  
 85  
 45  
 41.5.

Aug 23<sup>rd</sup>. And. at sunmet of  
 white copper ridge 100  
~~55~~ 55 100  
 of a 19 - 250 - 5775 - 10. a.m. 1  
 at sunmet of 6000 ft. 5985 - 10.30 - 2  
 " " of red shale 6750 - 11.30 - 3  
 top of hill  
 at 1. 2 p.m. 5850. 2x1m

Massive sand bank 111.  
 chert bed 150.

